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Construction of Military Intelligence Military Occupational Specialty Taxonomy

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Akman Associates, Inc.

for

Contracting Officer's Representative
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In 1987, the U.S. Army Intelligence Center and School (USAICS) requested that ARI investigate a number of military occupation specialty (MOS) issues arising from the development and introduction of new Intelligence/Electronic Warfare (IEW) collection and processing systems. A missing component of this research has been the development of an indepth taxonomy of the psychological processes and factors associated with each military intelligence (MI) and career management field (CMF). This research note describes a taxonomy developed to assess the suitability of MOS to meet the job performance demands of the introduction of new IEW systems. The taxonomy has three major levels: job-level variables, MOS-level variables, and CMF-level variables. These levels assume a sequential process that starts with micro-level evaluation of the impact of job changes on soldiers' tasks and leads to macro-level evaluation where the impact on MOS aggregates and CMF can be measured. The research note describes the technical approach and applies the taxonomy in describing the MOS of the 96 CMF.
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CONSTRUCTION OF MILITARY INTELLIGENCE MILITARY OCCUPATIONAL SPECIALTY TAXONOMY

EXECUTIVE SUMMARY

Requirement:

In 1987, the U.S. Army Intelligence Center and School (USAICS) requested that the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) investigate a number of military occupational specialty (MOS) issues arising from the development and introduction of new intelligence/electronic warfare (IEW) collection and processing systems. Since then, ARI has undertaken a variety of research efforts. A missing component of the research has been the development of an indepth taxonomy of the psychological processes and factors associated with each military intelligence (MI) MOS and career management field (CMF). Such a taxonomy can be used to assess the suitability of MOS to meet the job performance demands stemming from the introduction of new IEW systems.

Procedure:

Many taxonomies have been developed in order to support the analysis of job performance. Based on a review of the research literature published during the past 10 years, little taxonomic development for matching MOS capabilities and equipment demands has occurred. The taxonomy developed in this research note establishes the dimensions for evaluating MOS and IEW system demands. The taxonomy assumes a sequential process, starting with a micro-level evaluation of the impact of job changes on soldiers' tasks and leading to a macro-level evaluation where the impact on MOS aggregates and CMF can be measured.

Findings:

In the chapters of this report, the following issues are discussed:

- Existing taxonomies alone or in combination are not sufficient to meet objectives and requirements associated with assessing the suitability of existing MOS to meet job requirements of newly emerging IEW systems. Existing taxonomies, to the extent they are useful, have been incorporated in the proposed taxonomy.

- The proposed MI MOS taxonomy has dimensions that move from the micro-level to higher macro-levels; the taxonomy first focuses on job-level and task-level dimensions, the second level on MOS dimensions, and the third level on CMF dimensions.

- Using the MI MOS taxonomy, a catalog for the MOS in the 96 CMF has been developed. The catalog is presented in matrix form for seven MOS: 96B, 96D, 96H, 96R, 97B, 97E, and 97G.

Utilization of Findings:

The taxonomy reported in this research note serves as the foundation for future research efforts. In particular, the taxonomy will be used to describe the MOS of the 96 CMF. Second, the taxonomy will be extended to identify the job characteristics associated with selected future IEW systems. These catalogs will be used subsequently in developing analytical methodologies facilitating analysis of MOS capabilities and IEW system demands. These methodologies are also intended as a model for linking job requirements and demands with the capabilities of the human resources available for new jobs and equipments.

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CONSTRUCTION OF MILITARY INTELLIGENCE MILITARY OCCUPATIONAL SPECIALTY TAXONOMY

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CONSTRUCTION OF MILITARY INTELLIGENCE MILITARY OCCUPATIONAL SPECIALTY TAXONOMY

Introduction

This research note documents concepts and the technical approach used to develop a taxonomic structure for characterizing Military Occupational Specialties (MOSs). The report has been prepared as one of several reports being developed as part of a research effort focusing on the development of methodologies and techniques which can be used to evaluate MOS capabilities and system demands. The project is sponsored by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) under Contract No. DAHC35-89-D-0028 as part of its Manpower and Personnel Integration (MANPRINT) (Department of the Army, 1987) research program.

The overall objective of the research sponsored by ARI is to develop a systematic and quantitative basis for assessing the suitability of Military intelligence (MI) MOSs for current intelligence/electronic warfare (IEW) systems and those IEW systems to be deployed by 1996. The aim is to develop a taxonomy of psychological processes and MOS parameters which will support the matching of MOS definitions to new IEW system requirements and which will provide a basis for assessing job performance.

In the course of developing new IEW systems, there is a need to assess the suitability of projected personnel inventories to meet new job performance requirements. This is typically a difficult task because decisions are required early in the materiel development process when the equipment design is in flux and data are limited. Nevertheless, the time to make initial assessment is early in the development process when the personnel supply system can be given a long lead time to respond to new personnel and job performance demands.

The need to address these personnel selection decisions early in the development process has created a demand for techniques which identify and measure MOS capabilities and IEW system demands. Furthermore, techniques are required for comparing soldier capabilities and equipment requirements to determine when these are consistent and when they are not. Where there are incompatibilities, there are also requirements for techniques and analytical methods for determining ways to reduce or eliminate the inconsistencies.

The purpose of this report is to describe the approach used to develop a taxonomic structure which can be used to characterize MOSs, particularly those in the 96 Career Management Field (CMF), MI. Such data will serve as the basis for quantitative assessment of (1) the overall MI MOS inventory, (2)

the responsiveness of this MOS structure to meeting needs of emerging IEW technologies and equipments, and (3) the interaction of MI MOS requirements with soldier accession constraints and training costs.

Overview of Report

The research note which follows consists of five chapters. Together, they describe the concepts and approach underlying the MI MOS taxonomy.

The first chapter discusses the research issues and goals underlying this effort. The research objectives are identified. Issues and goals associated with the development and use of the MI MOS taxonomy are described. In addition, the study design and technical approach are explained.

The second chapter describes and defines the structure of the MI MOS taxonomy. An overview of the conceptual approach is given and each major structural element and each of the taxonomic categories, or taxa, are identified and described.

The third chapter illustrates the application of the proposed MI MOS taxonomy to the 96 CMF MOSs. The career field and its MOSs are described in general terms. Additionally, data pertaining to seven 96 CMF MOSs (96B, 96D, 96H, 96R, 97B, 97E, and 97G) addressed in this study are presented. In addition to examples of the data that can be used to describe the MOSs, data sources are identified.

The fourth chapter compares and contrasts the 96 CMF MOSs using the MI MOS taxonomy. Potential analytical techniques based on this comparative analysis are identified.

Finally, the last chapter presents conclusions and recommendations with respect to the use of the MI MOS taxonomy in subsequent tasking in this research.

Two appendices are included in this report as well. Appendix A presents a catalog of the 96 CMF MOSs based on the taxonomy. Appendix B provides an annotated bibliography identifying research reported during the past ten years which has been reviewed in the course of developing this research note and the taxonomy.

Research Issues and Goals

Over the years, many taxonomies have been developed for a variety of purposes. ARI has recently engaged in the development of the Taxonomic Work Station (TWS) which includes in its data base 13 different taxonomies which can be used singularly or in various combinations for different applications.

Research Objectives

The research described in this report is aimed towards providing the personnel proponent with techniques and methodologies that will lead to more systematic analyses. The research objectives are:

1. To design analytical techniques that are suitable for assessing the impact of current and future weapon systems on the MOS; and,

2. To design the analytical techniques specifically for application to MI MOSs and IEW systems.

Assess current and future IEW system impacts. An initial objective associated with this effort is to develop techniques suitable for assessing the MOS impacts resulting from current and future IEW systems.

The focus on equipment means that the taxonomies and analytical techniques should be designed to reflect explicitly equipment considerations. For example, equipment replacement, equipment obsolescence, and technology enhancements, among other equipment-oriented occurrences, must be accounted for in systematic and quantitative ways.

Focus on MI MOSs and IEW systems. The second objective underlying this research is to focus on MI MOSs and IEW systems. This objective requires that the research extend beyond generic analytical procedures and be tailored to deal with specific MOSs associated with specific classes of equipment.

The research products are to be designed to serve the MI community. Where MI career management fields are characterized by unique features such as information processing, data collection, imagery interpretation, among others, these processes will be captured in the taxonomies and methodologies.

Similarly, IEW equipment, to the extent of its uniqueness, will also receive special consideration in the design of the research products. Many of these systems are markedly different from equipment found elsewhere in the Army. The research

objective in this regard addresses current as well as future IEW systems.

This tailoring to specific MI and IEW applications underlies these research efforts. The initial focus on the 96 CMF and IEW systems to be deployed by 1996 will not, however, obscure the research requirement to extend the results to the 98 CMF and 33 CMF as well as future IEW equipment that will be fielded early in the 21st century.

Research Issues

While the assessment of the match between MOS capabilities and system demands has not yet benefited from systematic and quantitative techniques, the use of taxonomic approaches in developing such methodologies has many precedents. Thus, two issues must be addressed in the course of conducting this research:

1. Are there existing taxonomies that can be used to meet requirements for an MI MOS taxonomy?

2. What new benefits can be expected in the development of new taxonomy?

The limitation of existing taxonomies. Many different taxonomies have been developed to identify characteristics associated with human job performance (Fleishman and Quaintance, 1984). Taxonomies have been developed using a variety of principles and techniques. Notwithstanding these efforts, industrial psychologists continue to develop new taxonomies. The principal reason is that taxonomies are developed for specific purposes and, when the analytical purpose is significantly new, the use of existing taxonomies is limiting.

ARI has undertaken the development of the Taxonomic Work Station (TWS). TWS incorporates within its data base 13 different taxonomies. Using TWS, these taxonomies can be combined and manipulated to create new taxonomies to serve specific analytical purposes (McFann, Gray & Associates, Inc., 1989).

The taxonomic work that has already occurred represents a valuable, rich resource; however, these existing taxonomies are not sufficient alone or in combination to meet the objectives and requirements associated with MOS restructuring.

Some existing taxonomies offer useful components. Among these are the Fleishman abilities taxonomy and the TWS skills and cognitive abilities taxonomies. To the extent existing taxonomies and scaling techniques can be used, they are.

The benefits of new taxonomies. Taxonomies, when created, acquire their attributes in response to the specific purposes for which they are developed (Fleishman and Quaintance, 1984). Unfortunately, the existing taxonomies that may be useful often are very limited in scope. They tend to exist in forms suitable for potentially addressing only subsets of the issues that are critical in assessing the suitability of MOSs to meet job performance demands.

Decisions must account for job performance issues at the soldier, or micro, level. At the same time, the soldier is not trained to perform his job in a vacuum. In fact, other soldiers receiving similar or the same training perform jobs on different equipment. The MI MOS taxonomy needs to account for the micro level issues as well as the macro level issues in which the MOS is viewed as part of a much larger system. Therefore, consideration of a new taxonomy is appropriate and necessary. None that presently exists totally satisfies requirements for an MI MOS taxonomy.

Key dimensions required for an MOS taxonomy. Dimensions of a taxonomy are determined by purpose, classification, and application (Fleishman and Quaintance, 1984). The purpose of the MI MOS taxonomy is to provide the basis for quantitative assessment of the suitability of the MI MOS inventory to meet the needs of emerging IEW technologies and demands.

Given this framework, the taxonomy therefore must include dimensions related to the soldier, the soldier-equipment combination, the MOS, and the career management field. Data are potentially necessary permitting analysis at the micro level, i.e., the single soldier, to the macro level, i.e., aggregate requirements.

Study Design and Approach

Figure 1 illustrates the conceptual framework which is being used to develop taxonomies and methodologies in this research effort.

Initial work focuses on the 96 CMF MOSs, essentially the MOS and CMF supply. Once the taxonomic structure has been developed, the 96 CMF MOSs will be described with the taxonomy's attributes. A catalog of characteristics will be created for the following MOSs:

96B Intelligence Analyst
96D Imagery Analyst
96H Aerial Intelligence Specialist
96R Ground Surveillance Systems Operator

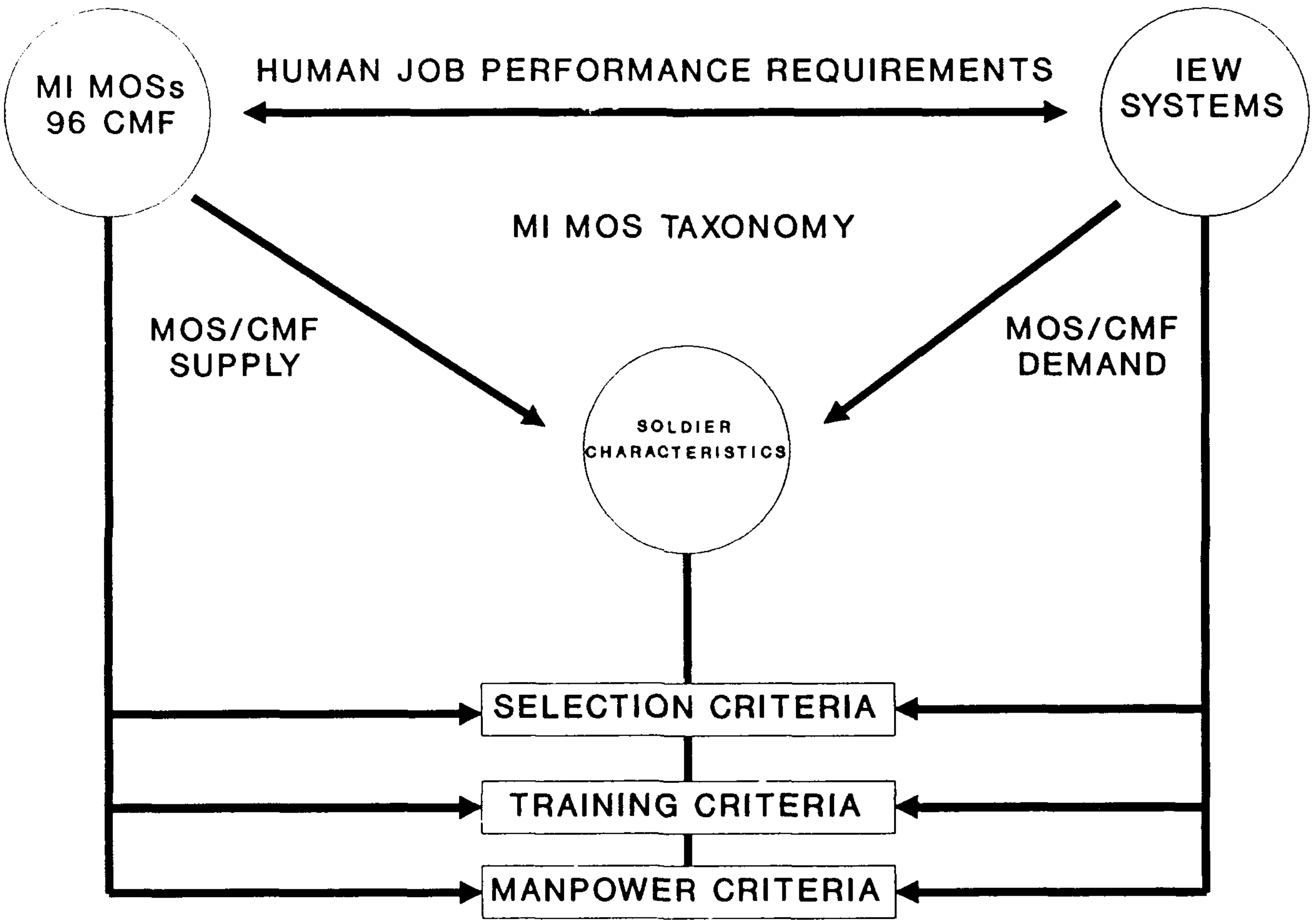

Figure 1. Conceptual framework for MI MOS analysis tool development.

97B Counterintelligence Agent
97E Interrogator
97G Counter-Signals Intelligence Specialist.

This report outlines the concepts underlying the taxonomy and research conducted in order to create the catalog.

A second focus of this research concerns the MOS and CMF requirements of current and future IEW systems. The taxonomy will be used to address four specific future IEW systems:

Joint Surveillance/Target Acquisition Radar (JSTARS)
Unmanned Aerial Vehicle (UAV)
Imagery Processing and Dissemination System (IPDS)
Commander's Tactical Terminal (CTT).

The taxonomy will permit the development of techniques to depict both the supply and demand of specific MOSs and IEW systems. The attributes will represent psychological descriptors as well as key non-psychological characteristics.

A third step in this research effort aims to develop techniques which will facilitate the assessment of the supply and demand attributes and determinations regarding the degree to which these match. In instances where the mismatches are significant, the techniques potentially include decision aids that will help determine the "best" ways in which to achieve consistency between the supply and demand.

The decision aids may be used to reveal changes needed in selection criteria, training criteria, or manpower criteria that in turn may lead to alternative combinations of taxonomic attributes.

MI MOS Taxonomy

The Army continuously reviews its missions, develops new plans and strategies, and acquires new equipment in order to fulfill its defense roles. The soldier's job, in this environment, is continuously evolving and changing. As these changes occur, there is need to determine whether existing occupational structures are the best structures for meeting these changes.

This chapter describes and defines the structures of an MI MOS taxonomy. The taxonomy is designed to be used in evaluating changes in soldier tasks and MOSs. The taxonomy establishes the dimensions for evaluation by defining the dimensions that should be measured and assessed when MOS changes occur.

During the materiel acquisition process, questions often emerge regarding the demands on the soldier and how the MOS might change. In the MI branch, the emergence of new technology incorporated in IEW systems raises questions regarding the best way to organize MI occupations and related CMFs.

Taxonomic Concepts and Applications

The MI MOS taxonomy, as developed here, assumes a sequential process starting with a micro-level evaluation of the impact of job changes on the soldier's tasks and leads to a macro-level evaluation where the impact on MOS aggregates and CMF can be measured.

For example, the apparently simple introduction of a computer terminal into the soldier's task and the subsequent changes in the task through work restructuring can lead to very great changes in what the job requires from people. These changes will be reflected in MOS selection criteria, training requirements, and the overall number of personnel needed for the MOS and the CMF.

The applications of the evaluation taxonomy are potentially multiple. Among these, first, the data derived from the application of the taxonomy should lead to a better description of the soldier's job and to increased precision in the classification of the MOS. This, in turn, should lead to improved description of the career management field into which the soldier is entering or in which he or she is progressing. In more general terminology, this is a continuing occupational analysis to ensure that the best possible use is made of the soldiers that are available in the force.

Second, the results of applying the taxonomy should be useful in evaluating new system designs where new or modified human tasks may result. There is a need to predict the possible

human resource consequences of new system designs to ensure that the existing manpower supply and manpower resources are adequate. For at least the next decade, there will be sharp restrictions on both the quality and quantity of manpower available for military service. The technology of the new systems must recognize those constraints. If the personnel and manpower demands of new system technology are excessive and if assumptions (explicit or implicit) about required personnel characteristics and availability are unrealistic, the advantages of the new technology will be greatly diminished or even erased; ultimately, force effectiveness will suffer.

The situation is shown graphically in Figure 2. New equipment, technology, constraints, and capabilities have the potential for transforming a current Job A into a revised Job A'. There exist at any time people performing current jobs (Soldier A) for which changes may, or may not, introduce new requirements in tasks, MOS, and CMF (Soldier A').

Figure 3 illustrates the place of a taxonomy in evaluating the change from Job A to Job A'. The change from Job A to Job A' may, or may not, result in a change in the soldier's tasks. In turn, this may, or may not, result in changes in the requirements for the soldier characteristics that are necessary to perform Job A'.

The range of possible consequences is very large. There may be no changes required, or a quite different set of soldiers may be necessary as a result of the change to the new tasks in Job A'. The applications of the evaluation method may be seen as a series of questions. The most general would be: What is the impact of the change from Job A to Job A'? Actually, there will be a series of increasingly detailed questions:

1. If there is a change from Job A to Job A', is the soldier who is currently performing Job A affected?

2. If there is a change, what are the specific changes in the dimensions defined by the evaluation taxonomy?

3. What is the impact of the changes on manpower, personnel, and training (MPT) variables at successive organizational levels?

4. What specifically should be done with respect to MOS criteria and subsequent career management field classification?

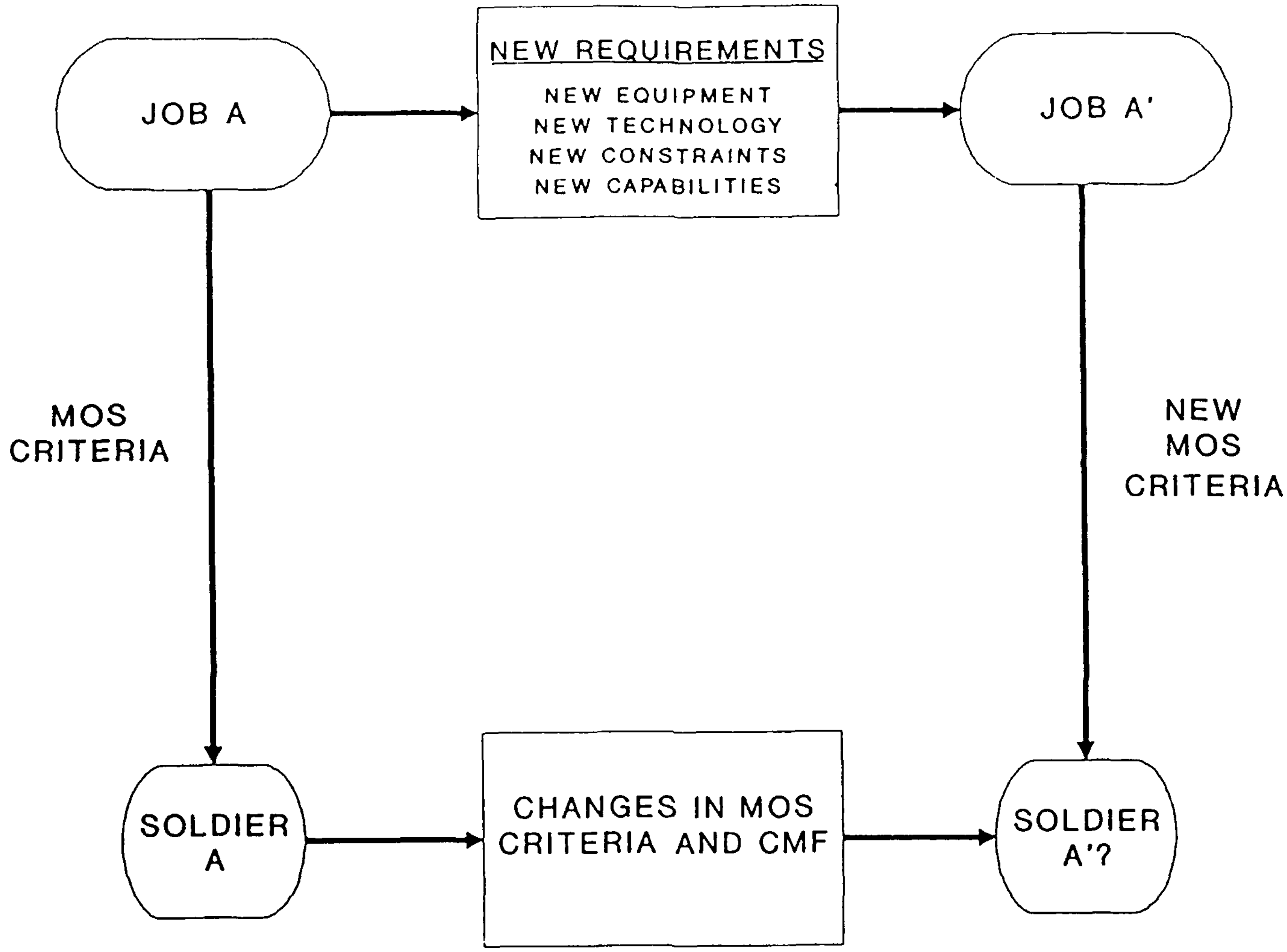

Figure 2. Evaluating MOS criteria and the CMF to meet changes in job requirements.

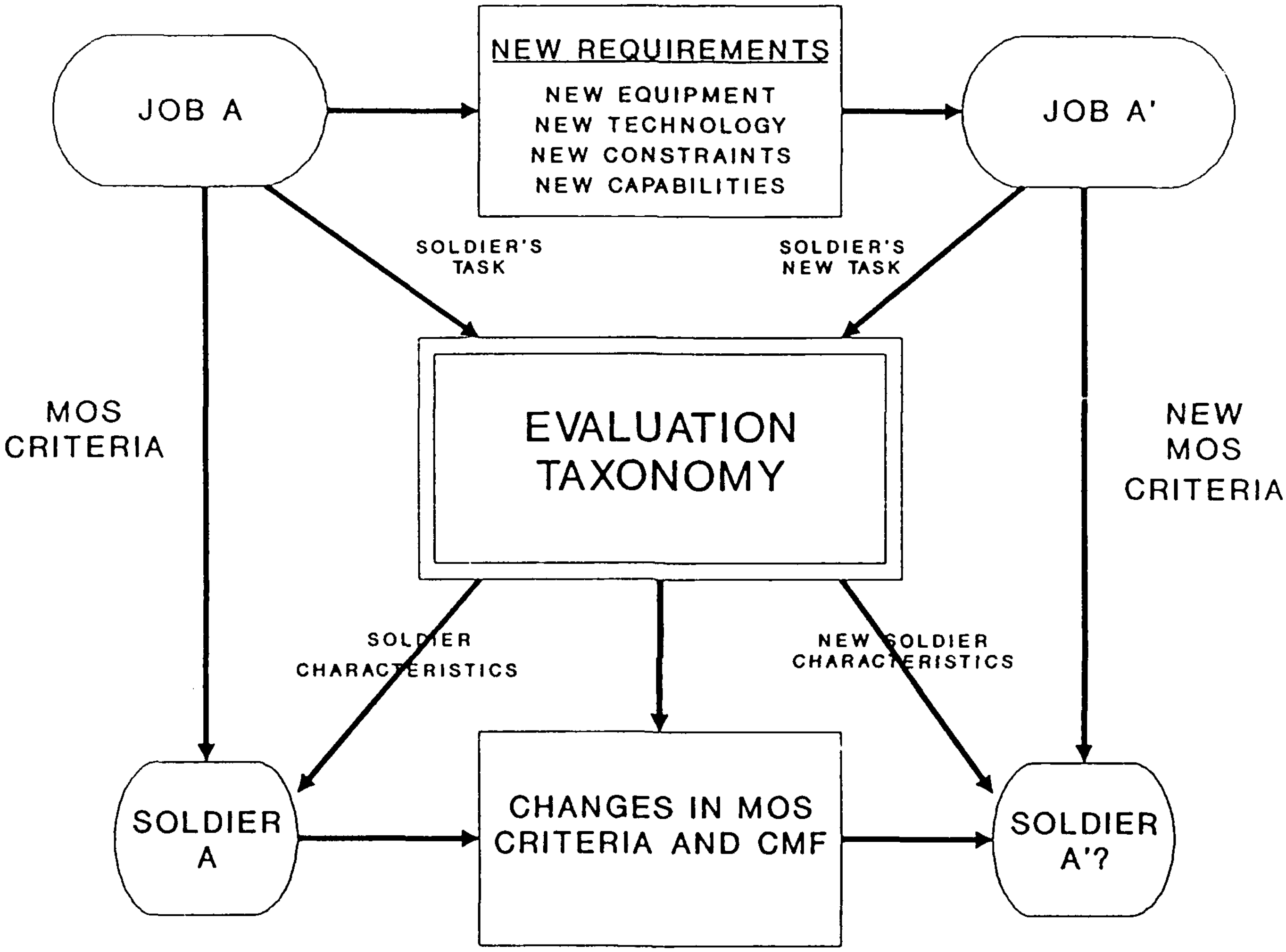

Figure 3. Using an evaluation taxonomy for MOS and CMF assessment.

The evaluation taxonomy can be used at any time, but perhaps the most useful in terms of avoiding later problems would be during system design. Before new systems and new equipments are produced and fielded, assessments should be made of the compatibility of evolving jobs and work restructuring with the characteristics of the existing soldiers.

The Evaluation Taxonomy

Table 1 presents the dimensions necessary for a MI MOS evaluation taxonomy. Three major areas of concern and several subareas within each are described:

1. Dimensions at the job-level and task-level including, on the one hand, critical task variables and, on the other, appropriate soldier characteristics provide the foundation. These dimensions describe the critical attributes of the job and the soldier as shown in the ovals in Figures 2 and 3.

2. The second level is that of the MOS description itself and five essential areas of dimensions assuming the information from the first level is also available.

3. Moving upward the third level is that of the career management field where some of the same dimensions are expanded and considered but also where new issues become paramount.

As one proceeds through the taxonomy, the focus shifts to broader, more aggregate levels of dimensions. This progression is specifically intended to be a move from the micro-level to higher macro-levels of analysis. The logic is that developed by Akman and Boyle (1988) for the Small Unit Maintenance Manpower Analysis/Air Force Specialty Impact Model (SUMMA/AIM), the SUMMA portion of which is appropriate to MOS analysis and the AIM portion to aggregates beyond. In this research, the evaluation is limited to MOS and CMF.

Given the existence of the measures from the dimensions shown in Table 1, the taxonomy must still be applied for evaluation. Table 2 shows this transformation. The evaluation emphasis is not on the dimensions <u>per se</u> but on the <u>changes</u> that occur due to work restructuring, i.e., changes that occur from Job A to Job A'. In every case, the key event will be the comparison of the dimension between Job A and Job A' at the job level and expanding to more complex comparisons at the MOS and CMF levels.

Table 1

A Taxonomy for Evaluating MOS changes

I. **JOB-LEVEL VARIABLES**

- A. CRITICAL TASK VARIABLES
  1. Workload Demands
  2. Physical Demands
  3. Skill Requirements
  4. Adverse Environments
  5. Organizational Requirements
  6. Performance Requirements

- B. SOLDIER CHARACTERISTICS
  1. Educational Requirements
     - a. Educational Level
     - b. Reading Level
  2. Mental Category
  3. Physical Abilities (PULHES)
  4. Abilities and Skills
     - a. Cognitive Abilities
     - b. Perceptual Abilities
     - c. Psychomotor Abilities
     - d. Flexibility and Coordination
     - e. Strength and Stamina
  5. Work Attitudes
     - a. Work Orientation
     - b. Dependability
  6. Special Requirements

II. **MOS-LEVEL VARIABLES**

- A. SELECTION(ASVAB) CRITERIA
- B. TRAINING REQUIREMENTS
- C. ACCESSION RATES
- D. RETENTION RATES
- E. PAYGRADE DISTRIBUTION

III. **CMF-LEVEL VARIABLES**

- A. TRAINING REQUIREMENTS
- B. ACCESSION RATES
- C. RETENTION RATES
- D. PAYGRADE DISTRIBUTION
- E. CAREER FIELD STRUCTURE AND MANAGEMENT

Table 2

Applying the Taxonomy to Evaluate the impact of MOS changes

I. <u>IMPACT OF TASK AND EQUIPMENT CHANGES ON JOB-LEVEL VARIABLES</u>

A. CHANGES IN CRITICAL TASK VARIABLES
   1. Changes in Workload Demands
   2. Changes in Physical Demands
   3. Changes in Skill Requirements
   4. Changes in Environmental Conditions
   5. Changes in Organizational Requirements
   6. Changes in Performance Requirements

B. CHANGES IN REQUIRED SOLIDER CHARACTERISTICS
   1. Changes in Educational Requirements
      a. Changes in Educational Level
      b. Changes in Reading Level Required
   2. Changes in Mental Category Required
   3. Changes in Physical Abilities (PULHES) Required
   4. Changes in Abilities and Skills Requirements
      a. Changes in Required Cognitive Abilities
      b. Changes in Required Perceptual Abilities
      c. Changes in Required Psychomotor Abilities
      d. Changes in Required Flexibility and Coordination
      e. Changes in Strength and Stamina
   5. Changes in Required Work Attitudes
      a. Changes in Required Work Orientation
      b. Changes in Required Dependability
   6. Changes in Special Requirements

II. <u>IMPACT OF JOB-LEVEL CHANGES ON MOS AND ON MPT ISSUES</u>

A. CHANGES IN MOS SELECTION(ASVAB) CRITERIA

B. CHANGES IN MOS TRAINING REQUIREMENTS

C. CHANGES IN MOS ACCESSION RATES

D. CHANGES IN MOS RETENTION RATES

E. CHANGES IN MOS PAYGRADE DISTRIBUTION

III. <u>IMPACT OF MOS CHANGES ON CAREER MANAGEMENT FIELD</u>

A. CHANGES ACROSS MOS TRAINING REQUIREMENTS

B. CHANGES ACROSS MOS ACCESSION RATES

C. CHANGES ACROSS MOS RETENTION RATES

D. CHANGES ACROSS MOS PAYGRADE DISTRIBUTION

E. CHANGES ACROSS MOS CAREER FIELD STRUCTURE AND MANAGEMENT

Indeed, the results will be profiles of comparison between changes. This will allow both an assessment of individual dimensions as well as an assessment across all dimensions within a section. Changes will bring differential effects without any necessary connection between dimensions. That there could be direct connections, however, is apparent; for example, looking at MOS impacts, a relationship between changes in ASVAB criteria and accession rates may well be expected.

Taxonomy Requirements

In constructing the taxonomy shown in Table 1 and the assessment structure given in Table 2, eight requirements were imposed which are in part constraints but in large part an attempt to keep the taxonomy practical and useful.

First, the taxonomy had to be reasonably consistent with tools and techniques currently in use operationally, such as the dimensions used in the current military occupational classification system (Army Regulation 611-1). This structures the descriptive problem in terms of position data analysis, personnel data analysis, impact on recruiting, impact on MOS identifiers, training needs and strategies, and physical demands analysis.

Second, there is a need to focus as closely as possible on the minimum necessary and sufficient set of dimensions to keep the evaluation procedure within manageable bounds. Because of the danger of being overwhelmed by trivial and useless detail, concentrating only on those parameters that will measure the impact of the transition from Job A to Job A' on the job, the MOS, and the career management field is important.

Third, there will be a flow of data and information from the micro to the macro-level. Questions asked at the CMF level will require data and information from the MOS and job levels.

Fourth, the accuracy and usefulness of the assessment at the MOS and CMF levels will be a direct function of the validity and reliability of the data collected at the job-related level.

Fifth, existing data will be used as much as possible. For example, dimensions in the Critical Task Variables use the position and task data already assembled in human factors engineering in system design, for development of training materials, and for various personnel performance requirements (e.g., critical task listings).

Sixth, established methods exist in the technology for measuring and assessing each of the dimensions. In this regard, the present taxonomy is variably successful. In some cases

(e.g., physical demands, PULHES) the methodology is clear; in others (e.g., retention), analysis is very complex and confused.

Seventh, each line item in Table 1 has alternative methods for data collection, with only a few exceptions. There are a wealth of choices for which there are advantages and disadvantages. Some of these options, and the relative values, will be described in the following sections, which discuss the three major areas of the taxonomy.

Finally, while not at issue in this report, the taxonomy has been built with the goal of being ultimately user-friendly with respect to the way it would be used. The general method would be profile analysis as assisted by expert systems technology. This method can be termed "intuitive graphic" as opposed to "tabular analytic", although full quantitative documentation would be made available.

A particular trap to be avoided is to assume that some form of computer augmentation relieves one of the careful selection of the minimal set of variables. In short, thanks to the computer, one can have as many variables as possible. While computer storage capability has become remarkable, major problems remain in (1) getting and updating data for multiple dimensions, (2) easily retrieving stored data in a form and package that the user wants (Muckler, 1987), and (3) establishing effective relational data bases despite all the claims that have been made for their future effectiveness.

Job-Level Variables

As shown in Table 1, there are two major sets of variables associated with the MOS evaluation at the job-related and task-related level: critical task variables and soldier characteristics.

Task decomposition. Analysis of human jobs and tasks is not a new issue, and there is a substantial technology for evaluating human work tasks. Often, the term "task decomposition" is used, which implies a conceptual simplifying and ordering of work for better understanding and more effective evaluation. One problem in this work has been what approach to use.

There are many techniques in the literature. Perhaps the most widely used in civilian technology is the Position Analysis Questionnaire (PAQ) developed by Ernest J. McCormick and his associates at Purdue University. The PAQ has been used on, and validated for, literally thousands of human jobs, and actually was developed initially for military positions (cf., Carter and Biersner, 1987; Harvey and Lozada-Larsen, 1988; Levine, Ash, and Bennett, 1980; Sparrow, 1989).

The PAQ generates seven general categories of job dimensions: information input, mental processes, work output, relationships with other persons, job context, other job characteristics, and general dimensions. Generated from job and task data, the PAQ establishes 44 parameters across the seven dimensions.

An alternate approach within the PAQ is deriving job dimensions based on attribute profile data, that is, job-contents based on human characteristics needed to perform the job. Examined this way, the first six dimensions only are measured (the "general" dimension is omitted) with a resultant set of 23 parameters in the six dimensions.

Table 1 presents a set of dimensions at the job level that resemble the PAQ approach, and some of the Table 1 dimensions are contextually similar or identical to specific PAQ dimensions. The most direct connection is through attribute profiles generated in the PAQ using the work of Fleishman and his associates (Fleishman and Quaintance, 1984). This will be described in the following discussion of abilities and skills. The total PAQ itself was felt not to be appropriate to this particular application.

In passing, other techniques might be noted: the Job Diagnostic Survey (Hackman, 1980; Harvey, Billings, and Nilan, 1985), the Job Characteristics Inventory (Aldag, Barr, and Brief, 1981; Pierce and Dunham, 1978), the Job Components Inventory (Banks, Jackson, Stafford, and Warr, 1983), the Multimethod Job Design Questionnaire (Campion and Thayer, 1985), the Occupational Analysis Inventory (Cunningham, Boese, Need, and Pass, 1983), and the Job Structure Profile (Patrick and Moore, 1985). If these do not suffice, one can use Delphi and policy-capturing techniques (Sanchez and Levine, 1989).

Critical task variables. As mentioned above, an assumption is being made that position and task data will be available and will not have to be collected for the evaluation method developed here. That prior data set becomes "task descriptive", and the analysis here becomes actually "task analysis" in the sense of extracting measures of six different dimensions. As shown in Table 1, these six are workload demands, physical demands, skill requirements, adverse environments, organizational requirements, and performance requirements. These six areas are essential to MOS description.

Workload demands. The introduction of new technology over the past three decades into human operator tasks has often had a startlingly variable impact. Extreme workload situations have been created. In some cases, the workload has diminished to the point where the operator is principally a system monitor, although with part-system failure the operator can suddenly find

himself faced with a very high workload demand. In other cases, where previous tasks have required only a medium workload, the new version has imposed many new tasks of high skill level requirements so that the workload may become high and continuous. Specifying changes in workload from Job A to Job A' and in MOS restructuring both are important.

From the standpoint of the present problem focus, there are at least two factors that warrant close measurement with respect to workload. First, the workload changes may be of the latter case where there are increases in quantity and quality of workload. Normally, this will involve the introduction of new equipments into old tasks. An example is the introduction of a computer terminal for the squad leader of the 155-mm howitzer which adds a totally new set of tasks and only partially replaces the old tasks he must do. In this case not only is there more workload but there are new tasks which require different abilities and skills.

A second factor is that either high workload or variable workload with high and low demand peaks directly affects the numbers of operators and maintainers that must be available to operate and maintain the system. Despite many claims to the contrary, new technology does not always, or even usually, reduce the number of system personnel. Indeed, and apart from any operator effects, there is often a significant increase in the number of maintenance personnel. In any case, a direct effect from workload demand at the individual job and task level can cascade into increased numbers of personnel at the manpower level. Thus, workload demand is an issue that runs from the micro- to the macro-level for MPT.

Physical demands. Changing job requirements may result in a change in physical demands placed on the soldier. Methods for measuring and rating physical demands in work have been well established (Fleishman, Gebhardt, and Hogan, 1984) and these ratings have been applied to every entry level Army MOS. With respect to such demands, both the amount and the frequency of demand loads are specified (Department of the Army, 1986, page 749). As physical demands change, becoming either heavier or lighter as a job changes, the MOS rating will also change.

There is a widespread belief that the general nature of changing jobs is such that physical demands are no longer of importance. The fact is that the majority of Army and civilian jobs continue to place physical demands on people. While heavy-duty manual labor has been reduced in many jobs, there are still many requirements for physical strength and stamina. For example, MOS 96H (Aerial Intelligence Specialist) "...frequently lifts 80 pounds 6 feet" and MOS 96R (Ground Surveillance Systems Operator) "...constantly bears loads of 60 pounds and walks 1 to 5 miles" (Department of the Army, 1986, page 749). Indeed, Army

jobs and tasks that require load carrying equal to or greater than human factors engineering standards are still commonly found (Department of Defense, 1989, page 214).

__Skill requirements__. In the cases just discussed, a direct result of technology changes could be an increase in skill requirements. The change from Job A to Job A' can add new skill requirements or increase skill requirements. Either may translate into two consequences: first, training requirements will be increased; second, a higher level of distribution of skilled personnel will increase paygrade distribution problems. In short, the same number of people in an MOS could cost a lot more money.

With careful and purposeful system design, the escalation of skill requirements can sometimes be avoided, and a job or task reskilled instead of upskilled. Often unless sufficient care and creative judgment are exercised, reskilling may result in a work environment that is 98 percent boredom and two percent panic. Neither state is conducive to high performance.

A further need here in considering skill requirements is to examine the changes that might occur in specific job-related knowledge resulting from the change from Job A to Job A'. This would be above and beyond basic skills and abilities. For example, adding computer subsystems may mean a remarkable increase in the need for specific knowledge about that computer and what it does with respect to the total system.

Identifying skill requirements precisely from candidate and prototype design is not easy in system development. This is a poorly developed methodology even though a great deal is known about how humans acquire skill (Lane, 1987). The problem is to identify specific skills and then translate them into specific skill and training requirements. Unfortunately, the result may often be unexpected increases in skill requirements which must be carefully considered in MOS analysis.

__Adverse environments__. Almost all military MOSs have work that must be performed in adverse environments. All of the MI MOSs considered in this study require performance in and around the battlefield and, at least, in possible nuclear-biological-chemical (NBC) warfare environments. The responsibility of human factors engineering design is to identify the effects of adverse environments on soldier performance. Some changes in work that result from technology have led to worse environments. One obvious case is where the new equipments may introduce the possibility of increased electrical and mechanical hazards. Complex equipments are rarely benign.

Adverse environments may have a negative impact on soldier performance, but they may also have a long-term negative

influence on work attitudes. In either case, the evaluation of work restructuring must consider both aspects closely. Again, the basic data and analyses should come from the human factors engineering system design effort, but the principal focus will be on job performance effects and the alleviation of adverse environments, if possible.

Organizational requirements. In civilian occupations, the introduction of new high-technology equipment has brought about some basic organizational changes. Perhaps the most well-known change has been the increased shift from hierarchical to "flatter" organizations with fewer layers of management and supervision. There is doubt that the Army will shift away from its traditional approach to organizational structure, but some MOS problems may be created.

One example might be the potential difficulty in identifying appropriate skill levels for career progression. Changed skill requirements due to particular equipments may be introduced midway in the skill level progression which would make for a less than straightforward upward progression. An example is the introduction of a complex computer terminal for the squad leader in the Howitzer Improvement Program. Nothing in his career and skill progression prepares the squad leader for that change.

At the present time, predicting what changes, if any, new technology will bring to operational and maintenance organizational requirements is very difficult.

Performance requirements. The ultimate purpose for all job and task changes is to obtain better performance. Accompanying the change from Job A to Job A' will be a statement of new performance requirements and higher levels of performance will be required from Job A'.

Many of the changes in jobs stemming from technology in recent decades have not resulted in increased performance. Indeed, in some cases, there have been drops in actual performance. This result was characteristic, for example, of the introduction of first-level automation to replace manual functions. The first semi-automation of air traffic control resulted in a drop of tracking capability from 7-9 simultaneous aircraft to 2-3. The problem was that both the manual and the semi-automatic systems were being operated with a constant number of controllers. In some human computer tasks, the time to perform was actually double that of the preceding manual task (Muckler, 1987). This kind of result is exceptional but happens often enough so that very careful developmental test and evaluation must be done to see exactly what levels of performance are being achieved.

Another common problem for new technology has been unreasonable expectations about performance improvements. Often, the new technology is very costly, and its cost-effectiveness has to be justified by the expectation or the promise of large leaps to better performance. The new technology may not be able to produce the promised performance improvement.

In confronting performance goals, developmental data must be made available on anticipated performance and actual performance. What may be involved is not just a large investment in technology but a large investment in personnel resources. For example, Job A' might require a radical increase in Mental Category I soldiers together with exceptionally extended training. If so, the change should have been justified by very necessary or very essential increased job and mission performance.

This discussion also indicates the kinds of tradeoffs that might be made in evaluating MOS restructuring. But cost and performance will not be the only criteria in such tradeoffs. Just as important will be questions of available manpower supply, expenditure of training resources, and rational MOS and career management field structures.

Soldier characteristics. The second category of attributes are soldier characteristics, those critical attributes that the soldier may be expected to bring to the new job. Of interest here is the question: If the job changes are such that required soldier characteristics change, what effect will that have on MOS restructuring? There are six dimensions in this category: educational requirements, mental category, physical abilities, abilities and skills, work attitudes, and special requirements.

Educational requirements. These parameters simply reflect the desired background and knowledge that the soldier could bring to task performance. Level of education is well-known to correlate directly with subsequent retention. Many MOSs have specific general and formal educational requirements. For example, military intelligence MOS 96D (Imagery Analyst) requires for entry level a high school diploma or the equivalent and successful completion of one year of high school algebra or geometry (Department of the Army, 1986, page 650).

Despite frequently expressed expectations that the computer would introduce a paperless Army, there seems instead an ever-growing dependence on hard-copy technical manuals and a concomitant emphasis on reading ability. Indeed, studies of the required reading levels of military manuals have suggested that very high levels of reading skills may be required. As Waters (1989) comments, "Research has consistently shown that there is a strong relationship between reading ability and job performance in the military. Thus, literacy levels are of great concern to those responsible for setting selection, classification, and

training policy. The need for greater reading skills has become increasingly more evident as military jobs have become more complex." Waters was reporting new Army research on Reading Scale Level scale to be added to the Armed Services Vocational Aptitude Battery (ASVAB).

Mental category. An essential measure in the area of soldier characteristics is an estimate of potential mental category distributions and how the capabilities they represent interact with job changes and work restructuring. Category I, the top level, represents a very narrow band as well as a very demanding standard. Not surprisingly, this category level is the least numerous and the most often requested category. The presumption that Category I is the universally best choice, regardless of task requirements, technology characteristics, or circumstances of employment does not follow. Nevertheless, there are, and will continue to be, severe shortages in the higher level mental categories and, at the same time, increased demand for better use of the more numerous lower mental category soldiers (cf. Horne, 1986).

Physical abilities (PULHES). This area concerns the physical abilities or the "physical profile" that has been derived for an MOS under the general heading of "PULHES":

P = Physical category or stamina
U = Upper extremities
L = Lower extremities
H = Hearing and ear
E = Eyes
S = Psychiatric.

Every Army MOS has a recommended PULHES profile. This profile is said to identify "...the broad physical demands of MOS and the physical abilities required to perform within the MOS..." (Department of the Army, 1986, page 10). As will be seen in the next section, the PULHES profile can and should be expanded in and coordinated with the general areas of ability and skill.

Abilities and skills. Every job requires some set of abilities and skills from the soldiers. For each job that set should be established and, when a job change occurs, a new set should be measured and compared with the original. There is a very rich technology available, and there are several ways of creating and making this comparison.

The first step is to establish a core list of abilities and skills to be measured. A great deal of data and several models exist for this step. In the present case, the work of Fleishman and Quaintance (1984) has been used, in conjunction with the structures defined for the ARI Taxonomic Work Station. Table 3 shows the set of 49 abilities and skills that have been selected

for the taxonomy, because they are considered to be most useful and necessary in evaluation of the MOSs of importance in this study. This list would be usable in a very wide variety of MOS settings. A slightly abbreviated list, for example, was directly applicable to MOS 13B (Cannon Crewmember) in previous work.

Given the set of abilities and skills shown in Table 3, the next step is to take a specific MOS and measure what abilities and skills are contained in the tasks for that MOS and the degree to which they are present. Not all abilities and skills will be required for any one MOS, and the degree to which their presence is required will vary in amount. There are several techniques for doing this type of "task decomposition". The method suggested here is a decision flow diagram technique developed by Fleishman and his associates (Mallamad, Levine, and Fleishman, 1980). Applied to both Job A and Job A', the method produces two sets of abilities and skills. Comparing these two sets permits an evaluation of the resultant changes in abilities and skills requirements.

Work attitudes. One of the most difficult areas to handle is the question of the soldier's attitudes about work. Attitudes toward work directly affect performance and levels of retention, partly as a function of job satisfaction (Finstuen, Weaver, and Edwards, 1982). Also important here is the need to measure motivation to perform the work (cf. Campion, 1989; Pasmore, 1982). Experience has long shown that performance differences are observable among soldiers of measurably similar skill and training profiles who have different attitudes toward work and different levels of motivation. The problem has been to develop effective measurement scales of attitude and motivation.

Recent work from ARI's Project A (Improving the Selection, Classification, and Utilization of Army Enlisted Personnel) has suggested two measures of work attitudes--Work Orientation and Dependability--that may be very useful indicators of soldier attitudes and temperament that influence their job performance.

Hanser, Birnbaum, and Bauman (1989) report empirical results that show Work Orientation and Dependability measures and predict job performance measures. Further, these measures and the abilities and skills dimensions just described (particularly in the cognitive domain) are complementary in predicting Army job performance. These results were based on the Armed Forces Qualification Test (AFQT) and job performance tests on 4,309 soldiers in nine MOSs.

Special requirements. With almost all MOSs there will be a small set of special requirements for that MOS. For example, with respect to military intelligence there is the specific problem of qualifying for security clearances of a special

Table 3

Abilities and Skills

A. COGNITIVE ABILITIES

1. Speech Comprehension
2. Reading Comprehension
3. Speech Expression
4. Written Expression
5. Memory
6. Problem Sensitivity
7. Number Facility
8. Deductive Reasoning
9. Inductive Reasoning
10. Information Ordering
11. Fluency of Ideas
12. Originality
13. Mathematical Reasoning
14. Category Flexibility
15. Speed of Closure
16. Pattern Recognition
17. Spatial Orientation
18. Visualization
19. Perceptual Speed and Accuracy
20. Selective Attention
21. Time Sharing

B. PERCEPTUAL ABILITIES

22. Near Vision
23. Far Vision
24. Visual Color Discrimination
25. Night Vision
26. Peripheral Vision
27. Depth Perception
28. Glare Sensitivity
29. General Hearing
30. Auditory Attention
31. Sound Localization

C. PSYCHOMOTOR ABILITIES

32. Control Precision
33. Rate Control
34. Reaction Time
35. Multi-Limb Coordination
36. Arm-Hand Steadiness
37. Manual Dexterity
38. Finger Dexterity
39. Wrist-Finger Speed
40. Speed of Limb Movement

Table 3

Abilities and Skills
(Continued)

D.	FLEXIBILITY AND COORDINATION
	41. Extent Flexibility
	42. Dynamic Flexibility
	43. Gross Body Coordination
	44. Gross Body Equilibrium
E.	STRENGTH AND STAMINA
	45. Static Strength
	46. Explosive Strength
	47. Dynamic Strength
	48. Trunk Strength
	49. Stamina

nature. To what extent these special requirements would be influenced by work restructuring would have to be determined for each case.

Job-level variables in the taxonomy are oriented around the possible consequences of work tasks on required soldier characteristics. These characteristics are defined in terms of six categories or areas: educational requirements, mental category, physical abilities, abilities and skills, work attitudes, and special requirements. How exhaustive these parameters are in the sense of being a necessary and sufficient measure set is not known. Each can be shown, however, to be directly applicable to soldier work performance and each may change if that work is restructured. Appropriate abilities and skills are essential for soldier job performance. Further, if the job change is a "deskilling" one which results in increased boredom, adverse changes may be expected in soldier attitudes, performance, and retention.

MOS-Level Variables

Once job-level variables in terms of task and soldier characteristics have been addressed, the next step is to consider the MOS in general and important MPT issues across the MOS category. The logic here is that developed by Akman and Boyle (1988) for both evaluations of MOS changes and subsequently the impact of MOS changes on career management fields and the entire force management problem. Of the many evaluation parameters that might be considered, five have been selected as critical: changes in selection (ASVAB) criteria, changes in training requirements, changes in accession rates, changes in retention rates, and changes in paygrade distribution.

Selection (ASVAB) criteria. Several pieces of information would be directly useful in evaluating the general need for MOS selection changes and specific need for ASVAB criteria changes: physical requirements, abilities and skills, and work attitudes. Indeed, all of the job level variables could have an impact on changing selection (ASVAB) criteria for the MOS. Data provided on required abilities and skills for Job A' would be directly associated with the selection of ASVAB subtests.

Training requirements. The principal sources of information for evaluating training requirements would come from abilities and skill analysis, workload demands, and skill requirements. How much data would be available from the normal training development program for the new system is difficult to estimate. Theoretically, the training system is supposed to be developed in parallel with the new weapon system, but rarely is. The training system and training data are often considered very late in the acquisition and design cycle.

At any rate, the important analysis pertains to specific new training requirements in comparison with the entire training program for the members of the MOS. Beyond the individual system or individual tasks for that system, a member of the MOS has received a wider training which should be compared for consistency and integration. The first objective is to find out if previous training is applicable to the new tasks, if the new tasks require any additional training, and, if so, what has to be done to provide the training.

Accession rates. A key manpower issue is the number of people who must be recruited each year to insure that the MOS manpower supply is adequate. As a result of changing requirements, the MOS in fact may be scheduled to be discontinued, or the jobs and tasks may now appear to be more logically a part of some other MOS. On the other hand, the new systems may demand an increase in the numbers of people in the MOS. Akman and Boyle (1988, page 15) ask three critical questions here:

1. Will the accession rate for the MOS increase or decrease?

2. Will the nature of the accession pool for the MOS be altered?

3. Will new accession policies or incentives be required?

Many of the basic data to answer these questions will come from the soldier characteristics analysis.

Retention rates. Mention has been made in several preceding sections about the relationships that might exist between retention and changes in the work structure and jobs. In fact, predicting precisely the quantitative relationship between retention and job characteristics is very difficult (Rosenthal and Laurence, 1988).

As noted above, there will be a direct relationship between retention and certain aspects of the job requirements such as monotony and boredom and deskilling. The connection between job characteristics and job satisfaction is translated into retention rates.

Another set of variables that is known to influence retention concerns the attitudes of the individual toward work. High individual motivation can overcome many adverse work conditions, at least to some extent and for some period of time.

Paygrade distribution. Technology cost investments would be offset if the new technology needed fewer workers at lower skill levels. This simply is not happening as technology is introduced

into the U.S. Army. Instead, soldier jobs are getting more complex, requiring more training, and demanding higher levels of skill competence. Paygrade level may also increase as higher levels of skill are needed.

The shift from Job A to Job A', therefore, may mean a paygrade "creep" upward with a higher distribution of ranks at E5 levels and above. The financial consequences of this shift are obvious. Existing personnel in the MOS are going to cost more over the entire MOS.

Beyond the cost problem, which cannot be overlooked, is another which should not be overlooked: if the soldier is expected to achieve higher levels of skill on more complex tasks, he or she may have to be recognized by appropriate symbols of rank that correspond to what he or she is expected to do. Denying this obvious fact can lead to retention problems and has done so. If these problems have not been adequately and successfully dealt with as the new technology was designed, by the time skill escalation and pay-grade creep need to be factored into MOS restructuring, few options are left. Ignoring the consequences of upskilling is not an alternative. Dealing with these consequences means recognizing the impact of technology on skill levels. The positive side is the opportunity to take advantage in enhanced mission performance of greater soldier skills and competence.

MOS Change and the Career Management Field

The next step calls for examining the impact of a single MOS change on the career management field of which that MOS is a part. Of the many possible consequences of that comparison, five are considered here: CMF training requirements, CMF accession rates, retention rates, paygrade distribution, and career field structure and management.

CMF training requirements. Under the assumption that the MOS training requirements have changed as a result of work restructuring, there is the possibility that some of the new training requirements might be supplied from other MOSs in the career management field. If the restructuring has impacted on more than one MOS, there is the further possibility for consolidation of training systems that would be available for two or more MOSs. The objective here is the most cost-effective training systems across the entire career management field.

Another major consideration is the potential for cross-training. At the least, a major objective for many years has been cross-training of personnel so that they develop the capability of performing, if required, in more than one military role. Further, if a given MOS should be discontinued, personnel from that MOS will be available in the labor pool, and an obvious

question is the degree to which cross-training has to be provided for the individual to qualify for a new MOS. Indeed, perhaps the first question is: What surviving MOS is the most appropriate transition target?

CMF accession rates. Whereas before the problem was sustaining appropriate accession in a single MOS, the problem now grows to all the MOSs in a career management field. Under the assumption that the career management field is a reasonably homogenous set of jobs across the individual MOSs, the requirements for personnel in all MOSs will have major similarities. Those commonalities can be taken advantage of in the flow of personnel into the entire career management field. Indeed, meeting shortages in particular MOSs as well as alleviating overages in others may be easier.

A major tool for controlling rates of accession is the cutoff score derived either from the AFQT or a particular composite (or both). Raising or lowering the cutoffs directly affects the number entering the MOS and the career management field. The information derived from the use of the taxonomy can assist in improving insights into the meanings and implications of various levels of cutoff scores.

Retention rates. The problem of predicting retention is no easier, or clearer, at the career management level than at the level of the individual MOSs. Apparently, job satisfaction remains the critical determiner of retention, and much will depend upon the job satisfaction that is gained or lost (or unchanged) in the move from Job A to Job A'.

However, job satisfaction could well depend upon more than the rewards and reinforcements of the particular job. Thus, "job" satisfaction could refer in the broader sense to the satisfaction of being a part of a particular MOS and, in turn, a career management field. Thus, job satisfaction could be based on the specific job, identification with the MOS, and being a part of the career management field. For example, it would seem very desirable that the soldier appreciate his specific task in airborne intelligence gathering as well as have a broader satisfaction in MOS 96H (Aerial Surveillance Specialist) and Career Management Field 96 (Military Intelligence).

Paygrade distribution. As there is a concern for paygrade distribution within the individual MOS, so there should be attention given to paygrade distribution across a career management field. Indeed, paygrade creep will not be controllable unless force-wide data and trends are known.

A basic problem for paygrade distribution is created, however, when new technology flows into a career management field, and training and skill requirements increase radically.

To be performed effectively, the new MOS tasks must have well trained and skilled personnel. To the extent appropriate and necessary, upskilling in turn must be recognized by granting higher rank. Then, the normal hierarchical organizational structures may become increasingly inappropriate. Flatter structures with fewer supervisors are probably more appropriate, but they are hard to reconcile with normal military structures.

Career field structure and management. At the present, career field structures are clearly defined (Department of the Army, 1986). They assume progression within an MOS from E3/E4 to Command Sergeant Major (E9) or Warrant Officer positions. Most appear to assume a linear move within a given MOS with a limit for that MOS at E8. If an MOS is discontinued, contingency moves, if they exist, are not apparent. Given the nature of the MOSs, moves can be made among them with greater or lesser ease. Career field management should begin to identify possible alternative career paths for an entire career.

The potential for such movement can be assessed from the kinds of data resulting from the evaluation taxonomy. Comparison profiles across MOSs within the career management field can identify commonalities which would ease transitions. The point is to achieve flexibility if required and to utilize more effectively the personnel force in place.

The MI MOS taxonomy presented in this chapter has dimensions that move from the micro-level to higher macro-levels. The taxonomy first focuses on job-level and task-level dimensions, the second level on MOS dimensions, and the third level on CMF dimensions. The taxonomic structure has been tailored to highlight those aspects of an MOS requiring explicit assessment when issues of new IEW technologies are being evaluated.

Application of the MI MOS Taxonomy to the 96 CMF

Once a taxonomy has been developed that is applicable to the MI MOSs, that taxonomy may be used to create a description of a specific MOS in terms of the taxonomy. This chapter discusses the application of the taxonomy to seven of the MOSs included in the 96 CMF:

MOS 96B: Intelligence Analyst
MOS 96D: Imagery Analyst
MOS 96H: Aerial Intelligence Specialist
MOS 96R: Ground Surveillance Systems Operator
MOS 97B: Counterintelligence Agent
MOS 97E: Interrogator
MOS 97G: Counter-Signals Intelligence Specialist.

The application of the taxonomy to the MOSs forms what may be called a "catalog" in which each MOS is described with respect to the characteristics represented in the taxonomy. That is, each taxon, or taxonomic category, is considered in turn for a given MOS to see what information is available with respect to that category.

The primary sources used in constructing this catalog were (1) Army Regulation 611-201, Enlisted Career Management Fields and Military Occupational Specialists, dated 30 April 1986; (2) the Footprints for 96B, 96D, 96H, 96R, 97B, 97 E, and 97G, all dated 06/01/89; and (3) various Critical Task Lists for the 96 CMF MOSs.

To provide a context for the discussion of the aspects of the seven MOSs recorded in the catalog, a brief narrative description of the major duties of each of the MOSs of interest here is presented below. In that way, each MOS will be more than a code and a name when the critical task list variables and the required solider characteristics are discussed. Following these descriptions, the catalog is presented and the kinds of data available for each part of the taxonomy are discussed.

The 96 CMF

The 96 CMF is one of the intelligence CMFs. Each separate MOS within the CMF deals with some aspect of the collection, interpretation, analysis, or reporting of intelligence. Thus a concern for intelligence information and issues provides a common thread across the seven MOSs. However, each MOS has a particular focus and area of responsibility, so the specific tasks carried out differ from one MOS to another.

Intelligence Analyst (96B). The Intelligence Analyst is concerned with the collection, processing, and dissemination of combat military intelligence, both strategic and tactical. He

must assess the significance and reliability of incoming information, integrate it with current intelligence holdings, and process the information so that it can be used. Processing includes the preparation of reports, estimates, plans, and briefings, as well as the establishment and maintenance of situation maps, intelligence overlays, intelligence records, and files.

The Intelligence Analyst must continually evaluate the importance of incoming information and promptly inform his superiors when it has immediate tactical value. He must assemble intelligence information from all possible sources and identify intelligence gaps and collection requirements.

At skill level 10, the Intelligence Analyst assists in some or all of these functions. As he progresses through skill levels 20, 30, and 40, he becomes increasingly involved in decision-making and in providing guidance to subordinates, tasking them and training them. At skill level 40, the analyst helps supervise combined information and intelligence coordination centers, coordinates target acquisition information with supported artillery, assembles enemy technical and scientific intelligence information and material, and coordinates requirements for translations of enemy technical documents and prisoner-of-war interrogations (cf. MOS 97E).

At skill level 50, in addition to guiding, supervising, and training subordinates, the analyst assists the commander and staff officers in the appraisal of intelligence, operations, and training procedures.

Imagery Analyst (96D). An Imagery Analyst is concerned with obtaining useful and valid intelligence information by studying and analyzing aerial and ground imagery, and by using electronic, optical, and mechanical devices to obtain information from permanent record images. He identifies physical features or terrain, as well as enemy installations, deployments, weapons, equipment, defenses, and lines of communication. He computes distances, areas, and volumes, with and without automated means, and determines field and target coordinates. He prepares a variety of graphics: situation maps, map overlays, plots, mosaics, charts, etc.

An Image Analyst plans imagery collection missions, briefs and debriefs the crews, assesses mission coverage, and makes recommendations for future missions. He prepares imagery reports, determines imagery analysis priorities, prepares and maintains target folders and imagery analysis files. He plans the use of air and ground reconnaissance and surveillance sensor systems. He must be familiar with the organizational levels he supports so he can respond appropriately to requests for imagery.

At skill level 10, he assists in the preparation of reports and graphics, operates and uses components of the Tactical Imagery Analysis Facility, and performs imagery analysis under the technical guidance of higher grade personnel. As he progresses through the skill levels, he assumes more responsibility for preparing imagery analysis reports and conducting studies of terrain, units, and equipment. He provides increasingly more supervision and training of lower grade personnel.

Aerial Intelligence Specialist (96H). The Aerial Intelligence Specialist helps to plan and carries out aerial missions, including aerial surveillance, aerial visual reconnaissance, aerial search and rescue, aerial radiological surveys, and similar intelligence and information-gathering missions. In addition to using his unaided but trained eye, he operates a variety of aerial sensor systems (infrared, radar, and photographic) and their associated data transmission links and ground data terminal stations.

The Aerial Intelligence Specialist recognizes enemy electronic countermeasures, whether directed against aircraft or ground component communications or sensor equipment, and he initiates electronic countercountermeasures. Prior to aerial missions, he helps the pilot with flight planning, weather analysis, navigational computations, and aircraft preflight procedures. While airborne, he reports on targets of opportunity, aids the pilot with aerial navigation, and uses the radio. He participates in mission debriefings and helps the imagery analyst analyze imagery recordings.

The Aerial Intelligence Specialist helps plan the use and management of aerial surveillance systems. He prepares aerial surveillance and associated equipment for operation, and he troubleshoots sensor and associated systems when they fail. He does preflight, preoperation, operator, and unit maintenance on assigned survival evasion resistance escape (SERE) equipment, and on associated equipment.

At skill level 20, the Aerial Intelligence Specialist begins to provide technical guidance and supervision to lower grade personnel, and at skill levels 30 and 40 trains as well as supervises them. At skill level 40, the Aerial Intelligence Specialist advises the commander with respect to internal assets and their use and the interface of aerial and ground surveillance systems. He participates in the management of aerial surveillance and associated systems.

There is no skill level 50 for MOS 96H; the career progression goes from 96H, skill level 40, to 96D, skill level 50, a position discussed on the preceding page.

Ground Surveillance Systems Operator (96R). The Ground Surveillance Systems Operator detects, locates, and reports target data by operating ground surveillance systems and associated equipment. That is, he selects emplacement sites for specific equipment, emplaces, camouflages, and recovers the system components. In carrying out his duties, he also operates organic communications equipment, power sources, and light-wheeled vehicles. He maintains the ground surveillance systems and associated equipment, as well as the light wheeled vehicles, the communications equipment, and the power sources.

The Ground Surveillance Systems Operator reconnoiters potential areas of operation, plans surveillance missions, and must be able to read and use the military maps, overlays, aerial photographs, terrain studies, and intelligence reports. He also prepares overlays and situation maps. He decides on employment and operational techniques for the ground surveillance equipment, integrates other unit collection assets with ground surveillance systems, and applies military intelligence collection processes and surveillance planning to operations.

Beginning with skill level 20 and continuing through skill level 50, Ground Surveillance Systems Operators provide technical guidance to lower grade personnel and supervise maintenance procedures, and at skill level 30 and above they provide more formal training. At skill level 50, responsibilities include helping to prepare and implement reconnaissance and surveillance operations plans and assisting the tactical surveillance officer in planning and coordinating the use of ground surveillance systems.

Counterintelligence Agent (97B). A Counterintelligence Agent plans and conducts counterintelligence operations, analyzing, selecting, exploiting, and neutralizing targets of counterintelligence interest in a tactical environment. He determines enemy intelligence collection assets, organizations, personnel, operational methods, capabilities, vulnerabilities, limitations, and missions. He supports offensive and defensive counterintelligence and collection operations and gathers counterintelligence information. He is familiar with the methods and practices of saboteurs, foreign agents, and subversives.

The Counterintelligence Agent formulates investigation plans and evaluates information sources. He plans and conducts counterintelligence investigations, including background, complaint, and incident investigations. He applies the fundamentals of military and civil law to the conduct of investigations. He conducts security surveys and provides other counterintelligence security services.

At skill level 10, the Counterintelligence Agent provides operational and administrative support as required. He compiles

collected counterintelligence information; prepares, types, and disseminates reports and summaries; gets recording and photographic equipment ready for operation; prepares interrogation rooms for use; and stores, inventories, and controls classified documents.

At increasing skill levels, he provides technical guidance to lower grade personnel. At skill level 40, he also plans, conducts, and supervises offensive and defensive counterintelligence operations, including organizing and coordinating the activities of counterintelligence support teams, such as those doing tactical collection tasks. At skill level 50, the Counterintelligence Agent collects, prepares, and disseminates material about intelligence operations; and supervises operations of the intelligence staff section in headquarters involving intelligence activities.

Interrogator (97E). An Interrogator conducts foreign-language interrogations of prisoners of war, enemy deserters, and civilians from enemy areas to get information necessary for developing military intelligence and then prepares reports based on these interrogations. To assess the veracity of the information obtained, he compares the information to other interrogation reports, captured documents, and intelligence reports.

In another use of his foreign language skills, an Interrogator translates foreign material into English and prepares summaries, extracts, or complete translation, as appropriate. In addition to translating foreign language combat orders, directives, records, and messages to get intelligence information, an interrogator may also translate foreign technical publications for information about the construction, operation, maintenance, employment, and characteristics of foreign equipment.

An Interrogator also translates material such as announcements, speeches, radio scripts, etc., into a foreign language for use with a non-English speaking population. An Interrogator also serves as an interpreter, translating foreign language conversations into English and English into a foreign language.

At skill level 10, in addition to performing interrogations and doing translations, an Interrogator helps to screen and search detained personnel, set up reference files of translation materials, and search available records to select individuals who may have information of military value. At skill level 20, Interrogators perform difficult translations at interrogations, provide technical guidance to lower level personnel, review and edit translations for accuracy and completeness, and act as interpreters. At the higher skill levels, Interrogators provide

on-the-job training as well as give technical guidance, monitor interrogations and translations for accuracy, decide on translation and file requirements, help to provide general intelligence training for command personnel, and act as interpreters and translators for general officers. At skill level 50, an Interrogator may supervise a strategic intelligence interrogation center or manage unit interrogation operations, as well as advise on the distribution and assignment of interrogation personnel; supervise intelligence interrogation training operations; and carry out high level technical interrogations.

Counter-Signals Intelligence Specialist (97G). The Counter-Signals Intelligence Specialist collects and analyzes data on communications and electronic activity, provides advice and assistance on electronic security and cryptosystems, and reviews and reports on counter-signals intelligence doctrine and activities. He prepares and executes deployment plans to support counter-signals intelligence operations.

At the lower skill levels, the Counter-Signals Intelligence Specialist operates communication equipments and maintains communications and communications security and monitoring equipment. He selects, erects, and orients tactical antennas; selects and uses commercial, battery, and generator power; monitors and records communications and produces transcripts; and prepares basic reports on counter-signal intelligence activities. At higher skill levels, the Counter-Signals Intelligence Specialist prepares counter-signal intelligence monitoring plans, plans and supervises electronic support activity, provides technical guidance to lower grade personnel and advice on the management of personnel equipment resources to upper echelons, and plans and executes counter-signals intelligence missions.

The 96 CMF Taxonomy

Table 4 catalogs characteristics for the 96 CMF MOSs using the MI MOS taxonomy. The rest of this chapter is devoted to a survey of what information is available, where it may be found, and what information is yet to be determined (TBD). Extracting the available information in each taxonomic category for each MOS and entering it in the intersection of the category with the MOS produces the catalog. Analysis within each MOS has been carried out to obtain the information shown.

Given the information contained in the matrix, comparisons across the CMF are possible. How these data are used to evaluate the CMF will be shown in the next chapter with quantitative data comparisons across the seven MOSs. How to cite these data at the

Table 4

MI MOS Taxonomy

TAXONOMY \ MOS	INTELLIGENCE ANALYST MOS 96B	IMAGERY ANALYST MOS 96D	AERIAL INTEL SPECIALIST MOS 96H	GRND SUR SYS OPERATOR MOS 96R	COUNTERINTELLIGENCE AGT MOS 97B	INTERROGATOR MOS 97E	CTR-SIGNALS INTEL SPEC MOS 97G
JOB - LEVEL VARIABLES							
CRITICAL TASK VARIABLES							
WORKLOAD DEMANDS	WORKLOAD MODEL; CRITICAL TASK LIST	WORKLOAD MODEL; CRITICAL TASK LIST	WORKLOAD MODEL; CRITICAL TASK LIST	WORKLOAD MODEL; CRITICAL TASK LIST	WORKLOAD MODEL; CRITICAL TASK LIST	WORKLOAD MODEL; CRITICAL TASK LIST	WORKLOAD MODEL; CRITICAL TASK LIST
PHYSICAL DEMANDS	MEDIUM	MEDIUM	MODERATELY HEAVY	VERY HEAVY	MODERATELY HEAVY	LIGHT	VERY HEAVY
SKILL REQUIREMENTS	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-50	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-50	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-40	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-50	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-50	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-50	SEE FOOTPRINT: REPORT 27 SKILL LEVELS 10-50
ADVERSE ENVIRONMENTS	BATTLEFIELD; NBC	BATTLEFIELD; NBC	AIRCRAFT;BATTLEFIELD;NBC	BATTLEFIELD; NBC	BATTLEFIELD; NBC	BATTLEFIELD; NBC	BATTLEFIELD; NBC
ORGANIZATIONAL REQUIREMENTS	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4	CAREER MGT& DEV CRITERIA AR 600-214; AR 600-200; DA PAM 351-4
PERFORMANCE REQUIREMENTS	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST
JOB - LEVEL VARIABLES							
SOLDIER CHARACTERISTICS							
EDUCATION REQUIREMENTS: EDUCATION LEVEL	HSG,GED	HSG,GED; 1 YR HS ALGEBRA OR GEOMETRY	HSG,GED; 1 YR HS ALGEBRA OR GEOMETRY	HSG,GED	HSG,GED	HSG,GED	HSG,GED
READING LEVEL	TBD	TBD	TBD	TBD	TBD	TBD/ECLT 72OOL QUALIFIED	TBD
MENTAL CATEGORY	SEE FOOTPRINT: RPTS 1&3	SEE FOOTPRINT: RPTS 1&3	SEE FOOTPRINT: RPTS 1&3	SEE FOOTPRINT: RPTS 1&3	SEE FOOTPRINT: RPTS 1&3	SEE FOOTPRINT: RPTS 1&3	SEE FOOTPRINT: RPTS 1&3
PHYSICAL ABILITIES (PULHES)	222221	222211	222111	222121	222221	222221	222121
ABILITIES AND SKILLS: COGNITIVE ABILITIES	VERBAL ABILITY; REASONING ABILITY; MEMORY; ARITHMETIC REASONING	VERBAL ABILITY; REASONING ABILITY; MEMORY; ARITHMETIC REASONING; PERCEPTUAL SPEED; SPATIAL RELATIONSHIPS	VERBAL ABILITY; REASONING ABILITY; MEMORY; ARITHMETIC REASONING; PERCEPTUAL SPEED; SPATIAL RELATIONSHIPS	VERBAL ABILITY; REASONING ABILITY; MEMORY; ARITHMETIC REASONING	VERBAL ABILITY; REASONING ABILITY; MEMORY	VERBAL ABILITY; REASONING ABILITY; MEMORY; DEF LANGUAGE BATTERY: 89	VERBAL ABILITY; REASONING ABILITY; MEMORY
ABILITIES/SKILLS PERCEPTUAL ABILITIES	NORMAL COLOR VISION;GOOD NEAR VISION; AUDITORY ACUITY; SPEECH CLARITY	NORMAL COLOR VISION; STEREOSCOPIC ACUITY;NEAR VISION CORRECTABLE; AUDITORY ACUITY; SPEECH CLARITY	NORMAL COLOR VISION; STEREOSCOPIC ACUITY; SPECIFIC NEAR AND DISTANCE VISION;AUDITORY REQUIREMENTS	NORMAL COLOR VISION;GOOD NEAR VISION; AUDITORY ACUITY AND SPECIFIC AUDITORY RQTS; SPEECH CLARITY	NORMAL COLOR VISION;GOOD NEAR VISION; AUDITORY ACUITY; GOOD VOICE QUALITY	NORMAL COLOR VISION;GOOD NEAR VISION; AUDITORY ACUITY; GOOD VOICE QUALITY; IDEOMATIC ENGLISH AND FOREIGN LANGUAGE	RED/GREEN COLOR DISCRIMINATION; GOOD NEAR VISION; SPEECH CLARITY; SPECIFIC AUDITORY RQTS
PSYCHOMOTOR ABILITIES	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	MECHANICAL APTITUDE SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST
FLEXIBILITY AND COORDINATION	MANUAL DEXTERITY AND HAND-EYE COORDINATION	MANUAL DEXTERITY AND HAND-EYE COORDINATION	MANUAL DEXTERITY AND HAND-EYE COORDINATION	MANUAL DEXTERITY AND HAND-EYE COORDINATION	NONE STATED BUT SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	NONE STATED BUT SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST	NONE STATED BUT SEE FOOTPRINT: REPORT 27 CRITICAL TASK LIST
STRENGTH AND STAMINA	SEE PULHES AR 611-201, P. 749	SEE PULHES AR 611-201, P. 749	SEE PULHES AR 611-201, P. 749	SEE PULHES AR 611-201, P. 749	SEE PULHES AR 611-201, P. 749	SEE PULHES AR 611-201, P. 750	SEE PULHES AR 611-201, P. 750

Table 4

MI MOS Taxonomy
(Continued)

TAXONOMY \ MOS	INTELLIGENCE ANALYST MOS 96B	IMAGERY ANALYST MOS 96D	AERIAL INTEL SPECIALIST MOS 96H	GRND SUR SYS OPERATOR MOS 96R	COUNTERINTELLIGENCE AGT MOS 97B	INTERROGATOR MOS 97E	CTR-SIGNALS INTEL SPEC MOS 97G
JOB - LEVEL VARIABLES							
SOLDIER CHARACTERISTICS (CONT.)							
WORKER ATTITUDES WORK ORIENTATION	TBD	TBD	TBD	TBD	TBD	TBD	TBD
DEPENDABILITY	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT	DEPENDABILITY; MATURITY; EMOTIONAL STABILITY;GOOD JUDGEMENT
SPECIAL REQUIREMENTS	TS CLEARANCE: SBI	TS CLEARANCE: SBI; SCI ELIGIBLE	HIGH ALTITUDE/LOW PRESSURE TRAINING; SECRET	SECRET CLEARANCE	TS CLEARANCE: SBI; SCI ELIGIBLE	SECRET CLEARANCE: SBI UNDERSTANDING OF GEO-POLITICAL AND SOCIO-ECONOMIC CONDITIONS OF FOREIGN COUNTRY	TS CLEARANCE: SBI; SCI ELIGIBLE
MOS - LEVEL VARIABLES							
SELECTION(ASVAB) CRITERIA	APTITUDE AREA: ST (SKILLED TECHNICAL)	APTITUDE AREA: ST (SKILLED TECHNICAL)	APTITUDE AREA: ST (SKILLED TECHNICAL) SC (SURVEILLANCE & COMM)	APTITUDE AREA: EL (ELECTRONICS) SC (SURVEILLANCE & COMM)	APTITUDE AREA: ST (SKILLED TECHNICAL) RESTRICTIONS: AR 601-210 AR 614-200	APTITUDE AREA: ST (SKILLED TECHNICAL) DEF LANGUAGE APTITUDE BATTERY: 89	APTITUDE AREA: ST (SKILLED TECHNICAL) SC (SURVEILLANCE & COMM)
TRAINING REQUIREMENTS	SEE FOOTPRINT: REPORTS 12,13,14,15,17	SEE FOOTPRINT: REPORTS 12,13,14,15,17	SEE FOOTPRINT: REPORTS 12,13,14,15,17	SEE FOOTPRINT: REPORTS 12,13,14,15,17	SEE FOOTPRINT: REPORTS 12,13,14,15,17	SEE FOOTPRINT: REPORTS 12,13,14,15,17	SEE FOOTPRINT: REPORTS 12,13,14,15,17
ACCESSION RATES	SEE FOOTPRINT: REPORTS 1 & 2	SEE FOOTPRINT: REPORTS 1 & 2	SEE FOOTPRINT: REPORTS 1 & 2	SEE FOOTPRINT: REPORTS 1 & 2	SEE FOOTPRINT: REPORTS 1 & 2	SEE FOOTPRINT: REPORTS 1 & 2	SEE FOOTPRINT: REPORTS 1 & 2
RETENTION RATES	SEE FOOTPRINT: REPORTS 10,11,16	SEE FOOTPRINT: REPORTS 10,11,16	SEE FOOTPRINT: REPORTS 10,11,16	SEE FOOTPRINT: REPORTS 10,11,16	SEE FOOTPRINT: REPORTS 10,11,16	SEE FOOTPRINT: REPORTS 10,11,16	SEE FOOTPRINT: REPORTS 10,11,16
PAYGRADE DISTRIBUTION	SEE FOOTPRINT: REPORTS 18,26	SEE FOOTPRINT: REPORTS 18,26	SEE FOOTPRINT: REPORTS 18,26	SEE FOOTPRINT: REPORTS 18,26	SEE FOOTPRINT: REPORTS 18,26	SEE FOOTPRINT: REPORTS 18,26	SEE FOOTPRINT: REPORTS 18,26

CMF level for the catalog is not yet clear. At present, therefore, the CMF variables (as listed in the taxonomy) have not been included in this table.

Job-Level: Critical Task Variables

Workload demands. Although no formal workload assessments of the 96 CMF MOSs appear to have been carried out, workload judgements are implicit in the decisions made about how many soldiers are assigned to given tasks and how much work is assigned to one soldier. The critical task lists developed for each MOS provide an indication of the range of tasks encompassed by the MOS but little help with respect to how often each is performed. Workload can be expected to vary considerably for these intelligence MOSs depending on the tactical situation and the particular duty assignment held. More quantitative estimates of the variability and supportability of workload demands within and across the 96 CMF MOSs could be obtained through the use of a workload model and the specifics contained in the critical task lists for the seven MOSs.

Physical demands. Each MOS has been assigned a physical demands rating. These ratings are listed in AR 611-201 (Department of the Army, 1986). This is the rating entered in the catalog.

Skill requirements. In Report 27 of the Footprint for each MOS, the tasks performed at each skill level are listed. The terminology used in discussing the skill cited in these listings is not directly or often easily convertible into the specific abilities and skills used in describing soldier characteristics. That is, a list of tasks for a given MOS is useful and necessary for determining skill requirements but is only the beginning of what must be done.

Adverse environments. AR 611-201 has no classification which specifies environmental conditions for an MOS, but the battlefield environment, and, further, NBC conditions must be presumed to represent the potential working environments for the MOSs. Other environmental conditions are sometimes implicit within task descriptions or implied by certain cited requirements, and have been deduced from such statements.

Organizational requirements. Information for this category does not currently exist as an item in some readily available list. Certain requirements may be imposed by career path considerations, by areas or conditions of certain assignments, or by other as yet unidentified constraints that may most appropriately be categorized as requirements imposed by organizational considerations. Additional sources for the requirements may be expected to surface as taxonomy development and testing progresses.

Performance requirements. Performance requirements are implicit in the task listings but, except for certain physical demands, they are not stated in easily quantifiable or even easily verifiable terms. Nonetheless, a good foundation exists.

Job-Level: Soldier Characteristics

Education requirements. Educational level is a specifically stated selection criterion. Reading level, in contrast, is currently an implicit rather than an explicit requirement, but the reality of needing to comprehend a wide range of written intelligence information as well as to use technical manuals, training materials, and other written information means that reading level measures may be at least as important as education level. The specific reading level needed for each MOS has yet to be determined (TBD).

Mental category. Reports 1 and 3 in each Footprint give information about the current distribution of soldiers within the MOS by mental category. Report 1 shows accessions by mental category for the most recent four years. Report 3 gives a seven-year breakdown for all active duty enlisted personnel within the MOS by mental category.

Physical abilities. The PULHES profile for each MOS has been determined and is listed in AR 611-201. The entries in the catalog are taken from that source.

Abilities and skills. In the catalog, abilities and skills are separated into five subcategories. The most specific source of data on these abilities and skills requirements is AR 611-201. It discusses two groups of basic mental qualifications for CMF 96: (1) a larger group that applies to both the Tactical Intelligence and Surveillance subfield (the 96 MOSs) and the Counterintelligence/Human Intelligence subfield (the 97 MOSs); (2) a smaller subgroup that applies to the former subfield and not the latter. In addition, AR 611-201 includes specific qualifications of specific MOSs. The catalog accumulates all these qualifications and categorizes them into one of the first four groups of abilities and skills: cognitive abilities, perceptual abilities, psychomotor abilities, or flexibility and coordination.

Report 27 in each Footprint and the critical task list for each MOS imply the need for additional psychomotor skills, but further analysis will be required to make these needs more specific and to express them in terms of the 49 abilities and skills listed as part of the MI MOS Process Taxonomy.

With respect to the fifth abilities and skills grouping, strength and stamina, the first three components of the PULHES are relevant, since "P" refers to overall physical capacity or

stamina, "U" to the upper extremities, and "L" to the lower extremities. In addition, Table B-1 of AR 611-201 cites specific physical tasks required of each MOS, together with an indication of the frequency (occasionally, frequently, constantly) with which the tasks must be accomplished.

Work attitudes. Requirements for work orientation, an attitude parameter related to job performance by Hanser, Birnbaum, and Bauman (1989), have yet to be determined (TBD) for any of the seven MOSs. The same authors cited the importance of dependability and that quality as well as others noted in the catalog are listed in AR 611-201 as 96 CMF requirements.

Special requirements. AR 611-201 was the principal source for additional, special requirements. Requirements for various security clearances and types of background investigations, including issues with which these investigations should be concerned, are noted in AR 611-201. The nature of special requirements can be expected to vary from one MOS to another, but in most cases AR 611-201 also should contain information about such requirements.

MOS-Level Variables

Selection (ASVAB) criteria. For each MOS, these criteria, as well as any classification and assignment restrictions, are referenced in AR 611-201.

Training requirements. Each *Footprint* includes a number of inputs summarizing various aspects of training relevant to the subject MOS. Report 12 shows quantity of personnel trained by year and by training type. Report 13 identifies training courses available at each skill level by course number and title and shows course length, class size, number of courses, total number of graduates, number of graduates on active duty as enlisted personnel, and the percentage of graduates who are currently active duty enlisted personnel.

Report 14 summarizes by course number and year the length in weeks and days of the various courses. Report 15 lists by year for the last six years the number of graduates from each training class within a course, as well as the totals for each course, who are currently active duty enlisted personnel. Report 17 summarizes by course number and title, and by year, the number of classes held, the average class size, the total number of graduates, the number of active duty enlisted graduates, and the average number of active enlisted graduates per class.

Accession rates. Reports 1 and 2 in each *Footprint* show accession trends over the last seven years for the MOS, Report 1 in terms of mental category and Report 2 in terms of ASVAB scores.

Retention rates. Three reports included in the Footprint deal with retention. Report 10 shows retention rate trends for the six most recent years as a function of four years-of-service groupings: 0-4 years; 5-10 years; 11-20 years; and more than 20 years. For comparison purposes, Report 11 repeats these data for the most recent year and also shows figures for the total Army, in terms of numbers and percentages. Report 16 shows retention figures in terms of specific training courses.

Paygrade distributions. Two Footprint reports provide data on paygrade distribution within an MOS. Report 18 shows for 1988 the number of active duty enlisted personnel within five grade groupings: E1-4, E5, E6, E7 and E8-9. These numbers are further broken down into quantity in the primary MOS, quantity with same-duty MOS, and percentage with same-duty MOS. Report 26 shows projections of force structure trends for eight years, in quantity and in percentages, broken down into the same five grade groupings.

Taxonomic Evaluation of 96 CMF MOS

The MI MOS Catalog presents data that can be used for an evaluation and assessment of the 96 CMF MOS structure. This evaluation can be done by looking at several of the basic commonalities and differences among the MOSs. Attributes are discussed with respect to the first two levels of the taxonomy. The analysis is not extended to the third level of the MI MOS taxonomy, namely, CMF-level variables, because, by definition, these characteristics do not differentiate features of individual MOSs but characterize the entire CMF.

Job-Level Variables: Commonalities and Differences

Physical demands. As the catalog shows, there is a very wide range in physical demands for the 96 CMF MOSs. One is light (97E), and two MOSs are very heavy (96R and 97G). These differences should be reflected in differential PULHES requirements; that they are not will be discussed below in "Physical Abilities (PULHES)".

Adverse environments. All the 96 CMF MOSs may be assumed to require battlefield and possibly a nuclear/biological/chemical (NBC) environment. However, one MOS operates in the airborne environment (96H) in contrast to all the other MOSs in this career management field. Because of that fact, one might question whether or not 96H is appropriate for this CMF or, at least, expect that requirements for 96H might be different in many of the taxonomic categories.

Education level. All listed MOSs have a basic requirement of the equivalent of high school education. Two MOSs (96D and 96H) add the additional requirement of one year of high school algebra or geometry. There is a great deal of accumulated evidence that high school graduates stay longer in the Army, although whether or not they perform differentially better than the non-high school graduates might be questioned. There are reasons for the algebra or geometry requirement for 96D and 96H; if required for those MOSs, similar education levels would also seem useful for 96B and 96R.

The actual levels of education in the seven MOSs are shown in Table 5. The overwhelming percentages of soldiers in this CMF have at least a high school education or the equivalent.

Reading level. With respect to reading level, first, quantitative analyses can be done of the reading level requirements for each MOS. There are several standard measuring

Table 5

Education Levels, 96 CMF

MOS	PERCENTAGE: FY 88		
	HIGH SCHOOL AND ABOVE	GED	NON-HIGH SCHOOL
96B	95	5	1
96D	97	3	1
96H	89	10	1
96R	87	11	1
97B	98	2	0
97E	97	2	0
97G	95	5	0

Source: <u>Footprint</u> Report 6, 06/01/89

instruments for this task. Second, quantitative numbers can also be computed for the soldier's reading level capability. Obviously then, a comparison can be made between requirements and capability. Very recent evidence (Waters, 1989) suggests that reading level capability may be determined from individual Armed Forces Qualifications Test (AFQT) scores or ASVAB scores.

Mental category. A major issue in force management is the need for higher level mental category performers (Horne, 1986). Data are available on seven MOSs in the 96 CMF with respect to distributions of mental categories. These data are shown for FY88 in Table 6. The distributions show a marked difference in the distribution of Mental Category I enlisted personnel. MOS 97E shows a very high level of Mental Category I personnel and, indeed, 84 percent of MOS 97E are found in Category I and II. A quite different distribution is shown for MOS 96R, with soldiers across all five mental categories, the majority distributed across categories II, IIIA, and IIIB. In short, 96 CMF shows quite varied differences in the quality of the soldiers available to the MOSs in that CMF. In standard occupational analysis, these differences might be sufficient to question the homogeneity of the career management field.

Of vital interest would be performance data on the differential performance of the individuals as a function of their mental category. There is much disagreement as to performance differences, and these disagreements can only be settled by actual performance data. All combat branches will want access to the higher level mental category soldier, but the question is how to evaluate these demands. There should be some optimal distribution for every MOS. Performance data are vitally needed for the best distribution of all mental category soldiers. The degree to which this might affect MOS classification is unknown.

Physical abilities (PULHES). The catalog listed the PULHES profiles for each MOS studied here. A somewhat more detailed description is given in Table 7. Looking at the table one would assume a high degree of commonality across the MOSs in 96 CMF. In the first three categories the scores are identical. Indeed, the only differences across MOSs is the H(hearing and ears) and E(Eyes).

However, the agreement for the first three categories--which refer to strength and stamina--are not consistent with the differential physical demands noted in the catalog and as shown by Table 8. This fact suggests that perhaps the PULHES levels should be re-determined for the first three PULHES dimensions. Possibly, there may be a much wider spread on the first three dimensions.

Table 6

Mental Category Distribution, 96 CMF

MOS	MENTAL CATEGORY PERCENTAGES: FY 88				
	I	II	IIIA	IIIB	IV
96B	9	50	20	12	6
96D	7	48	23	14	4
96H	9	51	23	11	4
96R	4	33	27	26	7
97B	17	59	13	5	1
97E	32	52	7	4	1
97G	6	54	27	10	1

Source: Footprint Report 3, 06/01/89, "Unknown" category not included

Table 7

PULHES Dimensions, 96 CMF

MOS	PULHES DIMENSIONS					
	Physical Category/ Stamina	Upper Extreme-ties	Lower Extreme-ties	Hearing and Ears	Eyes	Psychia-tric
96B	2	2	2	2	2	1
96D	2	2	2	2	1	1
96H	2	2	2	1	1	1
96R	2	2	2	1	2	1
97B	2	2	2	2	2	1
97E	2	2	2	2	2	1
97G	2	2	2	1	2	1

Source: AR 611-201, p. 749-750

Table 8

Comparison of Physical Task Loads, 96 CMF

MOS	PHYSICAL LOAD
96B	Occasionally lifts 25 lbs and carries 50 feet
96D	Occasionally lifts 25 lbs and carries 50 feet
96H	Frequently lifts 80 lbs and carries 6 feet
96R	Constantly load bears 60 lbs, walks 1-5 miles; Frequently lifts 55 lbs, carries 100 feet
97B	Occasionally lifts 50 lbs and carries 50 feet
97E	Occasionally lifts 20 lbs and carries 20 feet
97G	Occasionally lifts and lowers 218 lbs; occasionally pushes and pulls 520 lbs *

Source: AR 611-201, Table B-1

* Violates MIL-STD-1472D (Department of Defense, 1989)

Abilities and skills. Published sources provide many requirements for the seven MOSs in terms of abilities and skills. Here, "abilities and skills" refer to the basic underlying abilities and skills that are necessary to perform the tasks required by each MOS. By category, these commonalities and differences are noted:

- Three cognitive abilities are constant for all MOSs: verbal ability, reasoning ability, and arithmetic reasoning. Special additional requirements are given for MOS 96D, 96H, and 97E. Comparing, however, these cognitive abilities with the list given of 21 such abilities, these three do not appear to be a satisfactory representation of the cognitive abilities and skills needed to perform these MOS tasks.

- The requirements for perceptual abilities shown in the catalog compare reasonably well with the 10 perceptual abilities listed in the taxonomy.

- The only stated requirements in the catalog for psychomotor abilities is "mechanical aptitude". Examination of the MOS tasks for all MOSs suggests that there is a much wider use of psychomotor abilities.

- The stated requirement for flexibility and coordination is "manual dexterity and hand-eye coordination". Technically these are normally classed as psychomotor abilities (Fleishman and Quaintance, 1984). The four usual dimensions for flexibility and coordination are given in the taxonomy.

- The taxonomy also shows five dimensions normally correlated with strength and stamina. They should also be coordinated with the first three dimensions of the PULHES scale.

With respect to basic task abilities and skills, the catalog suggests that these abilities and skills need to be re-determined for all seven MOSs. An analytic method is available for such a determination (Mallamad, Levine, and Fleishman, 1980).

Dependability. As shown in the catalog, a stated requirement in this area is "dependability, maturity, emotional stability, and good judgement". Measurement instruments are available in the psychological literature for all of these concepts, and testing some of them with MOS personnel might be useful. A specific instrument for assessing Dependability has been tested by ARI research personnel very recently (Hanser, Birnbaum, and Bauman, 1989).

MOS-Level Variables: Commonalities and Differences

Selection (ASVAB) criteria. Like all Army MOSs, a variety of qualifications are required for initial entry into the MOS. One of particular interest is the Aptitude Area(s) examinations. In the catalog, Skilled Technical (ST) is the primary selection test for 96 CMF; only MOS 96R does not require this test. A second Aptitude Area examination, Surveillance and Communications (SC), is required for MOS 96H, 96R, and 97G. Finally, MOS 97E has a specific requirement for a minimum score on the Defense Language Aptitude Battery.

The specific tests that are used for selection are important:

1. Armed Forces Qualification Test (AFQT)

AFQT = AR + WK + PC + 1/2 NO

where: AR = Arithmetic Reasoning
WK = Word Knowledge
PC = Paragraph Comprehension
NO = Numerical Operations

2. Skilled Technical (ST): 96B, 96D, 96H, 97B, 97E, 97G

ST = MK + SK + AR

where: MK = Mechanical Knowledge
SK = Science Knowledge
AR = Arithmetic Reasoning

3. Surveillance and Communications (SC): 96H, 96R, 97G

SC = AP + PA + WK + MC + AR

where: AP = Auditory Perception
PA = Pattern Analysis
WK = Word Knowledge
MC = Mechanical Comprehension
AR = Arithmetic Reasoning

4. <u>Electronics (EL)</u>: 96R

$$EL = EI + SM + EI_1 + MC + AR$$

where: EI = Electronics Interest
SM = Shop Mechanics
EI_1 = Electronics Information
MC = Mechanical Comprehension
AR = Arithmetic Reasoning

For all of the seven MOSs there is one common aptitude test, Arithmetic Reasoning, which appears in the AFQT and in all three aptitude area tests.

How test scores on these aptitude area composites correlate with job performance is unknown. These correlations would indicate the validity of the tests and the composites. There should be some concern here, since the composites are known to correlate with training school performance but not necessarily with job performance.

A general algorithm for selection criteria can be written:

Selection Criteria = (General Ability) + (Knowledge) + (Aptitude) + (Interest) + (Physical Standards)

For the MI MOSs considered here, the AFQT is a representation of the dimension of general ability, and the PULHES a representation of minimum physical standards. The tests listed above in ST, SC, and EL are a combination of knowledge, aptitude, and interest tests. However, only MOS 96R is given an interest test (EI = Electronics Interest).

Training requirements. A great deal of training is given for each of the MOSs considered here since all require considerable skill development. But, as may be seen in Table 9, there is a great deal of variation in the duration of the initial skill level training courses. The shortest is MOS 96R, while the longest is MOS 96D. Part of this difference may be distributional--material to be learned can be distributed over the initial and subsequent training courses. But, if the length of the skill level one training courses is any indication of eventual skill requirements, MOS 96D would appear to make over twice the skill demands of MOS 96R.

Accession rates. All job categories everywhere probably require continuous concern about replacement and keeping a flow of personnel into the jobs. Table 10 shows the relative actions in accessions for the seven MOSs in FY88. There is a wide

Table 9

Skill Level One Training, 96 CMF

MOS	DURATION, FY 88
96B	14 weeks, 3 days
96D	18 weeks, 0 days
96H	8 weeks, 3 days
96R	6 weeks, 4 days
97B	14 weeks, 0 days
97E	14 weeks, 0 days
97G	7 weeks, 3 days

Source: Footprint Report 13, 06/01/89

Table 10

Accession Rates: FY88, 96 CMF

MOS	QUANTITY	ACCESSIONS	%
96B	3179	500	16
96D	891	150	17
96H	168	18	11
96R	1183	338	29
97B	1498	234	16
97E	1009	151	15
97G	480	131	27

Source: Footprint Report 1,3, 06/01/89

difference across the MOSs. With respect to the relative quantities across the MOSs, number of people in the MOSs vary by several orders of magnitude, with the smallest MOS 96H and the largest MOS 96B.

Retention rates. A crucial issue for all organizations is how many people stay with the organization. Table 11 considers the seven MOSs and their relative retention rates across three time segments. Overall the retention rates are very high (for FY87, a range of 82-89 percent), and retention rates over time appear to be reasonably stable.

Other Dimensions

In addition to the dimensions covered by the taxonomy, there are two additional characteristics of interest with respect to the comparison and characterization of the 96 CMF MOSs: gender differences and general experience levels.

Gender differences. A variable which was not included in the taxonomy or catalog was the question of gender differences among the MOSs in 96 CMF. Table 12 shows gender percentages by MOS by FY88. The range is from no females in the MOS (MOS 96R) to about one-fourth of force strength (MOS 97E). One problem in MOS 96R is that the physical demands are very heavy. On the other hand, the physical demands for 97G are also very heavy and 19 percent of the MOS are women.

General experience levels. One variable of considerable interest is an overall assessment of general experience levels of the work force. Table 13 shows some interesting values. The 96 CMF is a basically low experience work force with an average of 42 percent of the soldiers in these seven MOSs having less than four years of experience. Indeed, 73 percent have 10 or less years of experience. However, across the MOSs in the entire CMF there appears to be the same general distribution of years of experience within each of the MOSs.

Discussion

With respect to the eight job-level and the six MOS dimensions, the 96 CMF is fairly heterogenous with the following major differences:

- The tasks are performed in a wide variety of work settings from aircraft to one-on-one interrogation.
- The tasks in the various MOSs require a very wide variety of high technology equipment including, in one case (MOS 97E), none.

Table 11

Retention Rate Trends, 96 CMF

MOS	FISCAL YEAR PERCENTAGE		
	FY 83	FY 85	FY 87
96B	86	88	89
96D	83	87	89
96H	90	85	88
96R	--	74	87
97B	81	87	88
97E	--	85	84
97G	--	82	82

Source: Footprint Report 10, 06/01/89

Table 12

Gender Percentages: FY 88, 96 CMF

MOS	MALES	FEMALES
96B	83	17
96D	79	21
96H	92	8
96R	100	0
97B	85	15
97E	74	26
97G	81	19

Source: Footprint Report 21, 06/01/89

Table 13

Experience Levels, FY 88, 96 CMF

MOS	PERCENT YEARS OF EXPERIENCE			
	0-4 YEARS	5-10 YEARS	11-20 YEARS	>20 YEARS
96B	37	29	32	3
96D	44	31	22	2
96H	37	42	19	1
96R	44	25	30	2
97B	41	29	27	2
97E	48	29	22	1
97G	41	31	25	2
AVERAGE	42	31	25	2

Source: Footprint Report 9, 06/01/89

- There is the widest possible range in physical demands of the jobs.

- There is considerable variance in the distribution of mental category personnel from one MOS to another.

- By rating, the PULHES requirements appear to be very similar across MOSs, but in fact there are considerable differences in physical demands.

- In the current analysis of the basic abilities and skills to perform 96 CMF tasks, one core ability--Arithmetic Reasoning--is evaluated; while this ability is possibly necessary for all of the MOSs, it is certainly not sufficient.

- Initial training school requirements are radically different among 96 CMF MOSs, reflecting either a difference in training system design or a major difference in skill requirements.

- Accession rates differ considerably across the MOSs, as do the basic numbers of soldiers in each MOS.

- Female soldiers are used extensively in some of the 96 CMF MOSs and in one not at all (MOS 96R).

In some dimensions there is considerable similarity across MOSs:

- Level of achieved education is consistently high across all MOSs.

- Retention rates and trends are consistently high for all MOSs.

- The general level of experience as expressed in years of service is approximately the same across MOSs with a basic skewness in the direction of 0-10 years of military experience.

A fundamental assumption in the technology of job classification is that similar jobs should be grouped together. There are a wide number of techniques for uncovering and assessing similarities and differences among job families (cf., Harvey, 1986). The MOSs cannot as yet be evaluated with the techniques because there are insufficient data, but it seems a reasonable hypothesis that the 96 CMF does not form a homogeneous job family. On the other hand, at a very general level all of

these MOSs are concerned with "...the collection, analysis, development, protection, production, and dissemination of intelligence information..." (Department of the Army, 1986, page 116).

Conclusions and Recommendations

In continuing the development and evaluation of the MI MOS taxonomy, three classes of activities can be recommended based on findings and conclusions to date. These classes are additional data acquisition and scaling, profile development, and new equipment applications of the taxonomy.

Data Acquisition and Scaling

As discussed in the previous chapters, some additional data would be desirable to enhance the taxonomy and the catalog. In some cases, actual data should be collected; in many cases, generating scales of difficulty for a given parameter is what is needed.

Workload demand. Based on position and task data, a workload scale of difficulty measure should be generated for each MOS.

Skill requirements. Also using position and task data as well as selected information about relative training, scale values of difficulty can be generated for skill levels of each MOS.

Organizational requirements. Specific dimensions of this parameter need to be clarified.

Performance requirements. Based on position and task data and any Skill Qualification Test (SQT) data available, scale estimates of relative performance requirements for each MOS can be generated.

Reading levels. Selected samples of technical manuals and other appropriate reading material should be subjected to standard measures of reading level and then converted into relative scale values of difficulty. Reading capability may possibly be estimated from AFQT or ASVAB scores.

PULHES. A re-assessment of the current PULHES profiles is in order to make them consistent with variations in the physical demands of the tasks.

Work orientation. A test instrument is available to obtain data on this measure from the existing MI soldier population.

Dependability. An existing test instrument is also available for obtaining measures on this type of data.

For immediate usefulness, the pieces of the taxonomy and the catalog already available can be applied. But each additional parameter will enhance the taxonomy. In order of priority, probably most desirable would be completing data collection and scaling on workload demands, skill requirements, performance

requirements, reading levels, and PULHES. The parameters of work orientation and dependability are perhaps the most easily measured but also probably less direct than other variables that follow immediately from system and task demands.

Profile Development

The catalog represents a preliminary profile of each of the seven MOSs, but there remains much useful work in expanding and refining the profiles. Two major possibilities may be mentioned.

Abilities and skills. No area in the taxonomic description and evaluation of the 96 CMF and these seven MOSs needs more immediate work than abilities and skills. At present, the basic abilities and skills dimension for this CMF in terms of selection is Arithmetic Reasoning. This single attribute is incomplete and inadequate. Further, the Aptitude Area composite tests do not appear to reflect all of the actual abilities and skills implied by the specific tasks within each MOS.

Based on the specific abilities and skills dimensions listed in the taxonomy and the flow diagram method of Mallamad, Levine, and Fleishman (1980) expanded for all 49 dimensions, abilities and skills profiles should be determined for each of the seven MOSs.

The result will be seven specific profiles of abilities and skills essential to task performance, one for each MOS. Comparisons across MOSs will make showing commonalities and differences among the MOSs possible. Further, the specific profiles will give specific aid in deciding what abilities and skills should be measured in the selection process. The generality of and necessity for Arithmetic Reasoning can then be tested specifically. Finally, these profiles can serve as baseline profiles against which comparisons can be made when new equipments and systems are introduced into an MOS.

Total taxonomy scaling. All cells in the catalog can be converted into a common scale of relative difficulty or some other relevant parameter(s). Given that type of transformation, using an appropriate example of the many statistical techniques in the literature for occupational analysis becomes possible. For example, hierarchical cluster analysis could be used to evaluate quantitatively the seven MOSs as members of the career management field (cf. Christal, 1988; Harvey, 1986). This would allow testing 96 CMF as a job family and the seven MOSs as "jobs". Data of these kinds have been particularly useful in such personnel functions as training needs analysis and career path and progression planning.

New Equipment and Job Evaluation

A major purpose of the present work is to develop a taxonomic tool which will allow for assessments of the impacts of the new equipments and systems on current 96 CMF MOS jobs. Forthcoming for evaluation will be JSTARS, UAV, IPDS, and CTT.

The MPT consequences of job evolution determined to a large extent how the taxonomy and the catalog were designed. Therefore, the first step is the transformation of the new human performance job requirements created by the new equipments into the taxonomic dimensions. These new profile data will allow comparisons between the existing dimensions for a current MOS and a new dimensional profile for that MOS.

These comparisons will also be a "test" of the present taxonomy and particularly the adequacy of the dimensions. The most immediate impact of new equipment and systems will be on dimensions associated with the job-level variables and critical task variables. The very first question will be: How well do the six dimensions defined in the taxonomy describe the changes in human performance requirements brought about by the new equipment? Information gained on this and other critical methodological questions should lead to enhanced precision of the taxonomy.

To the degree that task demands change, there should be corresponding changes in required soldier characteristics. Given these results, the need for a revision of the MOS can be determined. Possible implications for selection, training, and performance requirements will at the least become apparent.

Further, if the appropriate MOSs appear to require significant change, they can then be compared across all seven MOSs for a test of the continuing validity of the 96 CMF. Thus, the analysis moves to the CMF level.

For some variables an examination of higher-level force implications could be desirable. For example, any possible and significant shifts in the distribution of mental category percentages should be closely checked. Even more important could be increases in manpower demand. Any new equipments and systems that place greater demands on manpower quantity and quality are questionable, given current manpower policies. The ability to expose these variables and their implications will be another level of "test" of the taxonomy and the catalog.

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Appendix A. Catalog of the 96 CMF MOS

This appendix presents a catalog of the 96 CMF MOS based on the MI MOS Taxonomy. These tables mirror the data presented in Table 4. There is a table for each of the seven 96 CMF MOS included in this research:

MOS 96B: Intelligence Specialist
MOS 96D: Imagery Analyst
MOS 96H: Aerial Intelligence Specialist
MOS 96R: Ground Surveillance Systems Operator
MOS 97B: Counterintelligence Agent
MOS 97E: Interrogator
MOS 97G: Counter-Signals Intelligence Specialist.

TAXONOMY	INTELLIGENCE ANALYST 96B
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Medium
Skill Requirements	See <u>Footprint</u>: Report 27 Skill Levels 10-50
Adverse Environments	Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See <u>Footprint</u>: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements: Education Level	HSG, GED
Reading Level	TBD
Mental Category	See <u>Footprint</u>: Reports 1 and 3
Physical Abilities (PULHES)	222221
Abilities and Skills:	
Cognitive Abilities	Verbal Ability; Reasoning Ability; Memory; Arithmetic Reasoning
Perceptual Abilities	Normal Color Vision; Good Near Vision; Auditory Acuity; Speech Clarity
Psychomotor Abilities	Mechanical Aptitude; See <u>Footprint</u>: Report 27; Critical Task
Flexibility and Coordination	Manual Dexterity & Hand-Eye Coordination
Strength and Stamina	See PULHES; AR 611-201, p. 749

TAXONOMY	INTELLIGENCE ANALYST 96B (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emotional Stability; Good Judgement
Special Requirements	TS Clearance: SBI
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: ST (Skilled Technical)
Training Requirements	See Footprint: Report 12, 13, 14, 15, 17
Accession Rates	See Footprint: Reports 1, 2
Retention Rates	See Footprint: Reports 10, 11, 16
Paygrade Distribution	See Footprint: Report 18, 26

TAXONOMY	IMAGERY ANALYST 96D (IMAGE INTERPRETER)
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Medium
Skill Requirements	See <u>Footprint</u>: Report 27 Skill Levels 10-50
Adverse Environments	Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See <u>Footprint</u>: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements: Education Level Reading Level	 HSG, GED; 1 year H.S. Algebra or Geometry TBD
Mental Category	See <u>Footprint</u>: Reports 1 and 3
Physical Abilities (PULHES)	222211
Abilities and Skills: Cognitive Abilities Perceptual Abilities Psychomotor Abilities Flexibility and Coordination Strength and Stamina	Verbal Ability; Reasoning Ability; Memory; Arithmetic Reasoning; Perceptual Speed; Spatial Relationships Normal Color Vision; Stereoscopic Acuity; Near Vision; Auditory Acuity; Speech Clarity Mechanical Aptitude; See <u>Footprint</u>: Report 27; Critical Task List Manual Dexterity & Hand-Eye Coordination See PULHES; AR 611-201, p. 749

TAXONOMY	IMAGERY ANALYST 96D (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emotional Stability; Good Judgement
Special Requirements	TS Clearance: SBI; SCI Eligible
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: ST (Skilled Technical)
Training Requirements	See Footprint: Report 12, 13, 14, 15, 17
Accession Rates	See Footprint: Reports 1, 2
Retention Rates	See Footprint: Reports 10, 11, 16
Paygrade Distribution	See Footprint: Report 18, 26

TAXONOMY	AERIAL INTELLIGENCE SPECIALIST 96H
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Moderately Heavy
Skill Requirements	See Footprint: Report 27 Skill Levels 10-40
Adverse Environments	Aircraft; Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See Footprint: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements: Education Level	 HSG, GED; 1 year H.S. Algebra or Geometry
Reading Level	TBD
Mental Category	See Footprint: Reports 1 and 3
Physical Abilities (PULHES)	222111; Class III Flight Physical
Abilities and Skills: Cognitive Abilities	Verbal Ability; Reasoning Ability; Memory; Arithmetic Reasoning; Perceptual Speed; Spatial Relationships
Perceptual Abilities	Normal Color Vision; Stereoscopic Acuity; Specific Near and Distance Vision; Auditory Requirements
Psychomotor Abilities	Mechanical Aptitude; See Footprint: Report 27; Critical Task List
Flexibility and Coordination	Manual Dexterity & Hand-Eye Coordination
Strength and Stamina	See PULHES; AR 611-201, p. 749

TAXONOMY	AERIAL INTELLIGENCE SPECIALIST 96H (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emotional Stability; Good Judgement
Special Requirements	High Altitude,Low Pressure Training Secret Clearance
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: ST (Skilled Technical) & SC (Surveillance & Communications)
Training Requirements	See <u>Footprint</u>: Report 12, 13, 14, 15, 17
Accession Rates	See <u>Footprint</u>: Reports 1, 2
Retention Rates	See <u>Footprint</u>: Reports 10, 11, 16
Paygrade Distribution	See <u>Footprint</u>: Report 18, 26

TAXONOMY	GROUND SURVEILLANCE SYSTEMS OPERATOR 96R
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Very Heavy
Skill Requirements	See Footprint: Report 27 Skill Levels 10-50
Adverse Environments	Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See Footprint: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements:	
Education Level	HSG, GED
Reading Level	TBD
Mental Category	See Footprint: Reports 1 and 3
Physical Abilities (PULHES)	222121
Abilities and Skills:	
Cognitive Abilities	Verbal Ability; Reasoning Ability; Memory; Arithmetic Reasoning;
Perceptual Abilities	Normal Color Vision; Good Near Vision; Auditory Acuity and Specific Auditory Requirements; Speech Clarity
Psychomotor Abilities	Mechanical Aptitude; See Footprint: Report 27; Critical Task List
Flexibility and Coordination	Manual Dexterity & Hand-Eye Coordination
Strength and Stamina	See PULHES; AR 611-201, p. 749

TAXONOMY	GROUND SURVEILLANCE SYSTEM OPERATOR 96R (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emotional stability; Good Judgement
Special Requirements	Secret Clearance
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: EL(Electronics) & SC(Surveillance & Communications)
Training Requirements	See <u>Footprint</u>: Report 12, 13, 14, 15, 17
Accession Rates	See <u>Footprint</u>: Reports 1, 2
Retention Rates	See <u>Footprint</u>: Reports 10, 11, 16
Paygrade Distribution	See <u>Footprint</u>: Report 18, 26

TAXONOMY	COUNTERINTELLIGENCE AGENT 97B
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Moderately Heavy
Skill Requirements	See Footprint: Report 27 Skill Levels 10-50
Adverse Environments	Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See Footprint: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements: Education Level	 HSG, GED
Reading Level	TBD
Mental Category	See Footprint: Reports 1 and 3
Physical Abilities (PULHES)	222221
Abilities and Skills:	
Cognitive Abilities	Verbal Ability; Reasoning Ability; Memory
Perceptual Abilities	Normal Color Vision; Good Near Vision; Auditory Acuity; Good Voice Quality
Psychomotor Abilities	Mechanical Aptitude; See Footprint: Report 27; Critical Task List
Flexibility and Coordination	None stated but see Footprint: Report 27; Critical Task List
Strength and Stamina	See PULHES; AR 611-201, p. 750

TAXONOMY	COUNTERINTELLIGENCE ANALYST 97B (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emotional Stability; Good Judgement
Special Requirements	TS Clearance: SBI SCI Eligible
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: ST (Skilled Technical) Restrictions: AR601-210; AR614-200
Training Requirements	See Footprint: Report 12, 13, 14, 15, 17
Accession Rates	See Footprint: Reports 1, 2
Retention Rates	See Footprint: Reports 10, 11, 16
Paygrade Distribution	See Footprint: Report 18, 26

TAXONOMY	INTERROGATOR 97E
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Light
Skill Requirements	See <u>Footprint</u>: Report 27 Skill Levels 10-50
Adverse Environments	Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See <u>Footprint</u>: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements: Education Level Reading Level	 HSG, GED TBD; ECLT 7200L Qualified
Mental Category	See <u>Footprint</u>: Reports 1 and 3
Physical Abilities (PULHES)	222221
Abilities and Skills:	
Cognitive Abilities	Verbal Ability; Reasoning Ability; Memory; Defense Language Aptitude Battery: 89
Perceptual Abilities	Normal Color Vision; Good Near Vision; Auditory Acuity; Good Voice Quality; Idiomatic English and Foreign language
Psychomotor Abilities	Mechanical Aptitude; See <u>Footprint</u>: Report 27; Critical Task List
Flexibility and Coordination	None stated but see <u>Footprint</u>: Report 27; Critical Task List
Strength and Stamina	See PULHES; AR 611-201, p. 750

TAXONOMY	INTERROGATOR 97E (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emctional Stability; Good Judgement
Special Requirements	Secret Clearance: SBI Understanding of geographic, social, economic, and political conditions of foreign country
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: ST (Skilled Technical); Defense Language Aptitude Battery: 89
Training Requirements	See <u>Footprint</u>: Report 12, 13, 14, 15, 17
Accession Rates	See <u>Footprint</u>: Reports 1, 2
Retention Rates	See <u>Footprint</u>: Reports 10, 11, 16
Paygrade Distribution	See <u>Footprint</u>: Report 18, 26

TAXONOMY	COUNTER-SIGNALS INTELLIGENCE SPECIALIST 97G (SIGNAL SECURITY SPECIALIST)
JOB-LEVEL VARIABLES: CRITICAL TASK VARIABLES	
Workload Demands	Workload Model; Critical Task List
Physical Demands	Very Heavy
Skill Requirements	See Footprint: Report 27 Skill Levels 10-50
Adverse Environments	Battlefield; NBC
Organizational Requirements	Career Management and Development Criteria; AR 614-200; AR 600-200; DA Pamphlet 351-4
Performance Requirements	See Footprint: Report 27 Critical Task List
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS	
Education Requirements: Education Level Reading Level	 HSG, GED TBD
Mental Category	See Footprint: Reports 1 and 3
Physical Abilities (PULHES)	222121
Abilities and Skills: Cognitive Abilities	 Verbal Ability; Reasoning Ability; Memory
Perceptual Abilities	Red/Green Color Discrimination; Good Near Vision, Speech Clarity; Specific Auditory Requirements
Psychomotor Abilities	Mechanical Aptitude; See Footprint: Report 27; Critical Task List
Flexibility and Coordination	None stated but see Footprint: Report 27; Critical Task List
Strength and Stamina	See PULHES; AR 611-201, p. 750

TAXONOMY	COUNTER-SIGNALS INTELLIGENCE SPECIALIST 97G (Continued)
JOB-LEVEL VARIABLES: SOLDIER CHARACTERISTICS (Continued)	
Work Attitudes:	
Work Orientation	TBD
Dependability	Dependability; Maturity; Emotional Stability; Good Judgement
Special Requirements	TS Clearance: SBI SCI Eligible
MOS-LEVEL VARIABLES	
Selection (ASVAB) Criteria	Aptitude Area: ST (Skilled Technical) & SC (Surveillance & Communications)
Training Requirements	See Footprint: Report 12, 13, 14, 15, 17
Accession Rates	See Footprint: Reports 1, 2
Retention Rates	See Footprint: Reports 10, 11, 16
Paygrade Distribution	See Footprint: Report 18, 26

Appendix B. Bibliography

Because of the unique applications of technology to human work in this century, one might expect a substantial body of related scientific and technical literature. In fact, while there is a large amount of partially relevant theory and data (as can be seen in this bibliography), there are few intensive and extensive studies *per se*. Therefore, one can only find parts of the problem addressed in the existing literature.

The principal search here was made with the invaluable aid of *Psychological Abstracts* from January 1979 (Volume 61) through September 1989 (Volume 76). Several keywords proved very fruitful: ability, aptitude measurement, Army personnel, career changes, intelligence measures, job analysis, occupational analysis, occupational success predictions, skill learning, task analysis, and taxonomies. In addition, certain journals (e.g., *Personnel Psychology*, *Journal of Occupational Psychology*, *Journal of Applied Psychology*, and *Psychological Bulletin*) and the references within the articles themselves were particularly useful for finding applicable materials.

For the most part, the abstracts given here are those provided by the authors in their articles.

Akman, A. and Boyle, E. (1988) Air Force Specialty Impact Model (AIM): Extensions to the SUMMA model. Unpublished.

Describes possible extensions of the SUMMA model. SUMMA (Small Unit Maintenance Manpower Analyses) is used to restructure maintenance jobs and to examine impacts on unit manning and related aspects of personnel and training for a specific weapon system. The extensions of SUMMA would carry the process beyond the unit level (or micro MPT) to force-wide impact analysis (or macro MPT). Both micro and macro approaches are needed to provide a more complete analysis of the maintenance specialty restructure problem. The macro-level analysis has been given an acronym, AIM (Air Force Specialty Impact Model).

Aldag, R.J., Barr, S.H., and Brief, A.P. (1981) Measurement of perceived task characteristics. Psychological Bulletin, 90(3), 415-431.

Reviews studies examining 6 psychometric properties (e.g., internal consistency and reliability, convergent validity, and substantive validity of 2 frequently used measures of perceived task characteristics-the Job Diagnostic Survey and the Job Characteristic Inventory. The evidence provides some support for the theoretical assumptions on which the scales are based, but it suggests serious difficulties as well. Alternative approaches to measurement of task characteristics and future directions for task design research are discussed. The need for more objective measures and for new theoretical paradigms is stressed.

Arvey, R.D., and Mossholder, K.M. (1977) A proposed methodology for determining similarities and differences among jobs. Personnel Psychology, 30(3), 363-374.

The determination of job similarities and differences is important (a) to satisfy legal requirements concerning validity generalizations, and (b) to justify, in some circumstances, collapsing across jobs for validational purposes. The ANOVA procedure proposed in this paper allows researchers to test for significant differences among jobs. Moreover, it permits the calculation of variance estimates to estimate the relative degree of similarities and differences among jobs. An example is presented.

Arvey, R.D., Maxwell, S.E., and Mossholder, K.M. (1979) Even more ideas about methodologies for determining job differences and similarities. Personnel Psychology, 32(3), 529-538.

R.M. McIntyre and J.L. Farr, L.M. Hanser et al, and R.W. Lissitz et al comment on the repeated measures ANOVA design suggested by R.D. Arvey and K.M. Mossholder to detect job differences and similarities. These authors propose alternative procedures to determine job differences. It is pointed out here that the problems specified by these critics may not be as severe as they indicate, and that some problems are even nonexistent. Moreover, the alternative solutions they suggest also have their own limitations. An additional procedure--a multivariate approach to repeated measures data--that might be useful in the context of detecting job differences is proposed. It appears that there are assumptions and limitations to both the univariate and multivariate approaches to the problem; these assumptions and limitations are delineated more precisely in the present paper.

Arvey, R.D., Maxwell, S.E., Gutenberg, R.L., and Camp, C. (1981) Detecting job differences: A monte carlo study. Personnel Psychology, 34(4), 709-730.

Investigated the power of the univariate repeated measures ANOVA design proposed by R.D. Arvey and K.M. Mossholder to detect job differences. Also examined was the relative value and usefulness of omega-squared estimates (OSEs) to indicate job similarities and differences. Job profile means and covariance structures were generated by using data from 6 similar jobs and 6 dissimilar jobs based on Position Analysis Questionnaire data bank information. Combinations of job differences (4 conditions), number of job rates (2 conditions), and violations of statistical assumptions (3 conditions) were generated. ANOVAs indicated that testing for significance was not as useful in determining job differences as examining OSEs. Specifically, the OSE for the interaction of the Jobs X Dimension effect was a sensitive and stable indicator of job differences regardless of the number of raters and violations of assumptions.

Baker, H.G., Berry, V.M., Kazan, J.B., and Diamond, E.E. (1988) Career plans checkup: Automated assessment of career maturity. Journal of Computer-Based Instruction, 15(1), 29-32.

The present article describes a paper and pencil career maturity assessment instrument developed and validated on 405 Army recruits. It was programmed to operate on Apple IIe and IBM microcomputers. This Career Plans Check-Up (CPC) and a criterion

measure of career maturity (My Vocational Situation) were administered to 100 male Navy recruits. The correlation between the CPC and the criterion was .81, implying that both primarily measured the same construct, career maturity.

Banks, M.H., Jackson, P.R., Stafford, E.M., and Warr, P.B. (1983) The Job Components Inventory and the analysis of jobs requiring limited skill. <u>Personnel Psychology</u>, <u>36</u>(1), 57-66.

Describes a job components inventory, a new job analysis technique examining the use of tools and equipment as well as physical and perceptual mathematical, communication, decision-making, and responsibility requirements. Results of a study of 100 job holders demonstrate a high reliability of the technique in terms of supervisor-job holder agreement, and the method is shown to discriminate successfully between and within job titles.

Boone, J.O. (1980) Toward the development of a new aptitude selection test battery for air traffic control specialists. <u>Aviation, Space, & Environmental Medicine</u>, 51(7), 694-699.

Five new experimental tests measuring aptitudes and skills that are considered important in air traffic work were administered to newly selected Air Traffic Control Specialist (ATCS) trainees on their 1st day of training at the Federal Aviation Administration Academy. The testing took place during a 21 month period from 1976-1978 and involved 1,800 trainees. The 5 experimental tests and the 5 tests now used by the Office of Personnel Management for selecting ATCS trainees were correlated with the averaged laboratory scores from Academy training. These correlations were then employed in an iterative stepwise regression (stepdown procedure). The tests that made a significant contribution in predicting Academy scores were then used to form a composite, and the multiple correlation was computed for the old and new tests batteries. The new composite demonstrated a statistically significant increase in the multiple correlation over the old battery. Some characteristics of the newer tests may have application for selection programs in other occupations.

Brown, C.J., and Kincaid, J.P. (1982) Use of the ASVAB for assignment of Gates-MacGinitie reading test levels. US Navy Training Analysis & Evaluation Group Report No. 82-4.

Administered Level D, E, or F of the Gates-MacGinitie Reading Tests (GMTRs) to 233 entering military recruits in order to relate Ss' reading ability levels to their Armed Services Vocational Aptitude Battery (ASVAB) scores from the 2 verbal

subtests, Word Knowledge and Paragraph Comprehension. ASVAB cutoff scores could then be derived for assigning a recruit to the GMRT of the appropriate difficulty level. Results suggest that administering Level D of the GMRTs to all Ss did not provide an accurate classificatory scheme. Using 3 levels of the test provided accurate reading grade levels for all Ss and made the GMRT an appropriate screening device for remediation programs at all stages of Navy training.

Brown, W.R., Dohme, J.A., and Sanders, M.G. (1982) Changes in the U.S. Army aviator selection and training program. Aviation, Space & Environmental Medicine, 52(12), 1173-1176.

Presents an overview of the development of the 1st Flight Aptitude Selection Test (FAST, implemented in 1966), the revised FAST (RFAST, implemented in 1980) and the predictive validity estimates for FAST and RFAST. The tests contain 4 content areas: biographical data and interest information, spatial ability, mechanical ability, and aviation information. RFAST was tested on 2,517 US Army aviation candidates to establish a mean and standard deviation.

Burtch, L.D., Lipscomb, M.S., and Wissman, D.J. (1980) Aptitude requirements based on task difficulty: Methodology for evaluation US AFHRL RF 81-34.

Describes the development and application of a technology designed for evaluating the difficulty of US Air Force jobs in conjunction with the aptitude level required for the job. The technology makes use of computed variables and task-factor data collected by the Air Force Occupational Measurement Center as well as benchmark difficulty data collected by contract personnel experts for the specialties under study. Analyses have indicated high interrater reliabilities for both supervisory and benchmark ratings.

Cain, P.S., and Green, B.F. (1983) Reliabilities of selected ratings available from the Dictionary of Occupational Titles. Journal of Applied Psychology, 68(1), 155-165.

Reports the reliability of a subset of 20 of the ratings available from the Dictionary of Occupational Titles, which provides rating of 46 characteristics for 12,099 occupations. Reliabilities were obtained for worker functions, training times, physical demands, and working conditions, using the generalizability technique, an ANOVA model that examined several potential sources of error. The test-retest reliabilities for these characteristics were generally excellent, indicating that ratings were done with great care. Most of the scales had

reliabilities above .70 when rater differences and job descriptions were also considered sources of error. The scales for characteristics measuring an occupation"s complexity of function in relation to things and its general educational development level in math fared less well, but reliabilities were still moderate. Ratings for service jobs were generally less reliable that ratings for manufacturing jobs.

Campion, M.A. (1988) Interdisciplinary approaches to job design: A constructive replication with extension. Journal of Applied Psychology, 73, 467-481.

This study replicated Campion and Thayer's (1985) research, which drew from many disciplines (e.g. psychology, engineering, human factors, physiology) to demonstrate four approaches to job design and their corresponding outcomes: motivational approach with satisfaction outcomes, mechanistic approach with efficiency outcomes, biological approach with comfort outcomes, and perceptual/motor approach with reliability outcomes. This study extended the research in fives ways. First, it used an expanded sample of 92 jobs and 1,024 respondents from a different industry. Second, a self-report measure was developed and evaluated, because many jobs cannot be analyzed observationally. Third, method bias was addressed by not finding evidence of priming effects, by demonstrating strong relationships even when within-subject bias was avoided, and by relating job design to independent opinion survey data. Fourth, reliability of aggregate responses was demonstrated, and relationships at the job level of analysis were larger than at the individual level. Fifth, neither individual differences in terms of preferences/tolerances for types of work nor demographics moderated job design-outcome relationships. It was concluded that different approaches to job design influence different outcomes, each approach has costs as well as benefits, trade-offs may be needed, and both theory and practice must be interdisciplinary in perspective.

Campion, M.A. (1989) Ability requirement implications of job design: An interdisciplinary perspective. Personnel Psychology, 42(1), 1-24.

Data were drawn from 2 previous samples researched by the author (M.A. Campion and P.W. Thayer, 1985; Campion, 1988). Sample 1 data were collected by observation of 121 jobs from 5 operations of a large forest products company. Sample 2 data were collected from 1,024 on 92 diverse jobs in a manufacturing and development facility of a large electronics company. Results substantiate previous findings that motivational attributes of jobs relate positively to mental ability requirements. The results show that mechanistic and perceptual/motor approaches to

job design relate negatively to mental ability requirements, whereas the biological approach relates to physical ability requirements.

Campion, M.A., and Thayer, P.W. (1985) Development and field evaluation of an interdisciplinary measure of job design. Journal of Applied Psychology, 70(1), 29-43.

Developed a taxonomy of job design approaches from the literature, including (1) a motivational approach from organizational psychology, (2) a mechanistic approach from classic engineering, (3) a biological approach from physiology and biomechanics, and (4) a perceptual/motor approach from experimental psychology. The Multimethod Job Design Questionnaire (MJDQ) was developed reflecting these approaches. A corresponding taxonomy of job outcomes was developed, and hypotheses were generated about relationships between job design approaches and outcomes. A field study of 121 jobs, 215 19-63 yr old job incumbents, and 23 27-58 yr old supervisors was conducted using this instrument . Results show that the MJDQ was reliable and that most hypotheses were supported. Jobs that scored high on the Motivational subscale had employees who were more satisfied and motivated, rated higher on job performance, and exhibited less absenteeism. Jobs high on the Mechanistic subscale had higher utilization levels and lower training requirements. Jobs high on the Biologic scale required less physical effort, produced fewer aches and pains, and resulted in fewer medical incidents. Jobs high on the Perceptual/Motor scale were less likely to produce accidents, errors, stress, work overload and required fewer mental demands. Sample items are appended.

Carter, R.C., and Biersner, R.J. (1987) Job requirements derived from the Position Analysis Questionnaire and validated using military aptitude test scores. Journal of Occupational Psychology, 60(4), 311-312.

Mental and physical abilities of incumbents in selected US Navy jobs were compared with job requirements predicted using the Position Analysis Questionnaire (PAQ). A significant pattern of correlations was found between commercially available PAQ attribute predictions derived from 25 Navy jobs and mental abilities measured using the Armed Services Vocational Aptitude Battery. Significant relationships were also found between physical strength requirements of 26 Navy jobs and PAQ-based predictions of job requirements. Results support use of the PAQ to establish differences of ability requirements among jobs. Specific applications are discussed (e.g., the use of the PAQ in research on environmental stress).

Christal, R.E. (1988) Theory-based ability measurement: The Learning Abilities Measurement Program. Aviation, Space & Environmental Medicine, 59(11, Section 2), 52-58.

Describes an Air Force program devoted to the development of a science-based system of ability measurement. A history is given of ability testing and research in the military services, along with statement of the value of ability testing for making personnel selection and classification decisions. Although few advances in ability measurement have been made in the last two decades, the availability of microcomputers and progress in understanding human cognition create possibilities for a breakthrough. Examples are provided of recent studies that hold promise for forecasting individual differences in learning efficiency, performance capabilities, and susceptibility to information overload. Also discussed is a program that encourages university scientist to make use of Air Force Ss and testing facilities.

Companion, M.A., and Corso, G.M. (1982) Task taxonomies: A general review and evaluation. International Journal of Man-Machine Studies, 17(4), 459-472.

Develops a set of criteria by which specific task taxonomies could be evaluated and contrasted. Additionally, 4 general taxonomies (including task as a behavior requirement) and 5 specific taxonomies (including the abilities approach and the information approach) are reviewed. It is concluded that future efforts must reevaluate the importance of taxonomic development vs the integration of empirical human performance data into a useful, predictive tool.

Cornelius, E.T., Carron, T.J., and Collins. M.N. (1979) Job analysis models and job classification. Personnel Psychology, 32(4), 693-708.

Recent research in job classification has focused on the appropriate data analysis model for analyzing the similarities and differences on jobs. In the present research, the data analysis model was held constant, and the type of job analysis data was varied to examine the effect on the resulting job classification decisions. Seven foreman jobs in a chemical processing plant were analyzed by job analysts and foreman using 3 levels of job analysis data: task-oriented, worker-oriented (Position Analysis Questionnaire), and abilities-oriented. All 3 sets of data were analyzed using the same hierarchical clustering procedure. Results indicate that the number and type of resulting clusters were clearly dictated by the type of job analysis data that was used to compare the foreman jobs.

Cornelius, E.T., DeNisi, A.S., and Blencoe, A.G. (1984) Expert and naive raters using the PAQ: Does it matter? Personnel Psychology, 37(3), 453-464.

J.E. Smith and M.D. Hakel (see PA, Vol 65:4564) found that job expert ratings on the Position Analysis Questionnaire (PAQ) correlated highly with ratings obtained from college students who were given no information about jobs other than their titles. One possible explanation for this finding is that the PAQ measures only trivial or common knowledge about work that both experts and naive observers possess. The present authors point out a problem in the way Smith and Hakel calculated the convergent validity between expert raters and naive raters and discuss results from a replication study with 39 undergraduates that show convergent validates much lower than those reported by Smith and Hakel.

Cornelius, E.T., Hakel, M.D., and Sackett, P.R. (1979) A methodological approach to job classification for performance appraisal purposes. Personnel Psychology, 32(2), 283-297.

Examined the effects of a series of organizational development (OD) techniques. Four work groups were included in the study, two experimental and two control, with one or two noncommissioned officers and 12-14 enlisted persons in each. Groups performed identical tasks, which involved finding and monitoring communications and abstracting information from them; however, the experimental groups used OD strategies in carrying out the tasks. These groups participated in tests of three OD techniques: survey feedback, participative problem solving, and job enrichment. Dependent variables were data from a work environment questionnaire and performance criteria. Results show positive changes in soldier perceptions and performance after the OD programs. The importance of being able to affect lower levels of the Army organization with these techniques is discussed as are qualifying factors for their success in other settings.

Cory, B.H., Johnson, C.D., Korotkin, A.L. and Stephenson, R.W. (1980) Duty modules: An approach to the identification and classification of personnel resources and requirements. Catalog of Selected Documents in Psychology, 10, 99. MS 2165

Cranny, C.J., and Doherty, M.E. (1988) Importance ratings in job analysis: Note on the misinterpretation of factor analyses. Journal of Applied Psychology, 73(2), 320-322.

A common practice in job analysis involves having subject matter experts (SMEs) provide importance weights for the behaviors identified as characteristics of a given job, and then grouping those behaviors by factor analysis. Two problems with using factor analysis on these data are explored: (a) the factors that emerge from such an analysis are not interpretable as important dimensions of the job, and (b) job dimensions that SMEs agree are important will not emerge as factors.

Crystal, J.C., and Deems, R.S. (1983) Redesigning jobs. Training & Development Journal, 37(2), 44-46.

Notes that as organizations change, new needs emerge and existing needs diminish. It is suggested that organizations can increase productivity and morale by implementing a program of redesigning jobs. Jobs can be restructured by identifying employees' most refined skills, and most productive work environment, and by identifying changing organization needs.

Cunningham, J.W., Boese, R.R., Need, R.W., and Pass, J.J. (1983) Systematically derived work dimensions: Factor analyses of the Occupational Analysis Inventory. Journal of Applied Psychology, 68(2), 232-252.

Developed the Occupation Analysis Inventory (OAI) for use as a taxonomic tool, derived a broad set of human work dimensions (factors) based on that questionnaire, and established some degree construct validity for the resultant dimensions. 602 OAI work elements (items) were subjected to several factor analyses based on the ratings of 1,414 jobs on the elements and ratings of the elements on their requirements for 102 defined human attributes. The resultant factors were significantly related to the tested abilities of relevant job holders. It is concluded that job-rating factors should be (a) fairly reflective of the various types of work activities and conditions extant in the world of work and (b) unique in their coverage of information relevant to occupational education and career decision making.

David, F.R., Pearce, J.A., and Randolph, W.A. (1989) Linking technology and structure to enhance group performance. Journal of Applied Psychology, 74(2), 233-241.

We examined linkages between technology and structure at the group level of analysis as predictors of group performance. The general hypothesis is that group technology/structural fit is a

better predictor of work group performance than either technology or structure alone. Related hypotheses match three technology variables (task predictability, problem analysis ability, and interdependence) with three group structural variables (horizontal differentiation, vertical differentiation, and connectedness) to predict group structural properties alone. Technology variables are very poor predictors alone. The fit variables add significant explained variance over the above technology and structural variables as universalistic predictors. Predictions about which technology and structural variables to match for higher group performance are generally supported. These results could allow future contingency research to make greater contributions to theory building about group performance.

DeNisi, A.S., Cornelius, E.T., and Blencoe, A.G. (1987) Further investigation of common knowledge effects on job analysis ratings. Journal of Applied Psychology, 72(2), 262-268.

Previous research (Smith & Hakel, 19979) raised the possibility that the Position Analysis Questionnaire (PAQ) only captures common knowledge, or stereotypes, about jobs. Cornelius, DeNisi, and Blencoe (1984) presented data to refute this, but found that the number for PAQ items rated does not apply (DNA) was related to the agreement between naive raters and expert raters. The present study used data from 87 analysts and 24 jobs. Naive ratings were those obtained from raters who had not studied the job, whereas expert ratings were those obtained from raters who had observed the job, interviewed incumbents, and written task statements describing the job. These ratings were then compared to target-score profiles obtained from PAQ services. Results confirmed earlier hypotheses that large numbers of DNA items artifactually inflate correlational estimates of agreement between expert and naive raters. In addition to this artifact, results also supported the view that the PAQ is less appropriate as a job analysis tool for some types of jobs. Implications for research and practice are discussed.

Department of the Army (1986) Enlisted career management fields and military occupational specialties. Washington, DC: Army Regulation 611-201.

Department of the Army, Guide for preparation of changes to the military occupational classification structure (MOCS), (1988). Alexandria, VA: Soldier Support Center - National Capital Region, 1988.

Department of the Army (1987) Manpower and personnel integration (MANPRINT) in materiel acquisition process. Washington, DC: Army Regulation 602-2.

Department of Defense (1989) Military standard: Human engineering design criteria for military systems, equipment, and facilities. Washington, DC: MIL-STD-1472D.

Downs, C.G., (1988) Representing the structure of jobs in job analysis. International Journal of Man-Machine Studies, 28(4), 363-390.

A prominent cause of structure (intrinsic, overall, and properties of constituents) in jobs is identified as the intentionality of human action. It is argued that, in principle, certain elements from Q-analysis (a social science methodology that enables structural features of phenomena to be formally represented) can be used to represent both the structure of job constituents and the overall structure of jobs. The concept of set definition from Q-analysis methodology is examined to determine how it may be applied in job analysis. The metric mathematical basis of certain conventional techniques used for comparison of jobs is contrasted with the topological character of Q-analysis.

Drasgow, F., and Miller, H.E. (1982) Psychometric and substantive issues in scale construction and validation. Journal of Applied Psychology, 67(3), 268-279.

Presents a procedure for assessing the success of a scale in measuring an underlying construct. This procedure (a) provides a quantitive index of the relation between a scale and its underlying factor, (b) provides guidance in interpreting reliability coefficients, (c) indicates one case where the multitrait-multimethod procedure may lead researchers astray, and (d) aids development of scales suggested by clearly articulated theory. The five Job Descriptive Index scales were examined with this procedure in Exp I with 1,046 retail employees. Each scale was found to relate highly with a single underlying construct. In contrast, results for the Job Characteristic Inventory scales completed by 851 National Guard Members in Exp II are less compelling and suggest that 3 of these scales (task identity, task variety, and dealing with others) may benefit from further refinement.

Droege, R.C., and Boese, R. (1982) Development of a new occupational aptitude pattern structure with comprehensive occupational coverage. Vocational Guidance Quarterly, 30(3), 219-229.

Describes a meta-analysis of the 460 Specific Aptitude Test Batteries (SATBs) undertaken to form a limited number of Occupational Aptitude Patterns (OAPs) and to extend coverage of the OAPs to most of the 12,000 occupations defined in the US Department of Labor's Dictionary of Occupational Titles (1977). The objectives were achieved by performing a homogeneity analysis of the SATBs to establish work groups and by developing OAPs for these groups. The new OAP structure has a criterion-related validity base, relatively few patterns, and comprehensive occupational coverage.

Dunbar, S.B., and Novick, M.R. (1988) On predicting success in training for men and women: Examples from Marine Corps clerical specialties. Journal of Applied Psychology, 73(3), 545-550.

The presence of differences between prediction systems for men and women is investigated through a detailed study of clerical occupational specialties in the U.S. Marine Corps. When various measures of ability were used to predict success of recruits in training, sizeable differences in regression equations were found between men and women. The study showed that selected deletion of extraneous Armed Services Vocational Aptitude Battery (ASVAB) variables maintained overall predictive efficiency but did not entirely remove the differences between subgroup regressions. When the attainment of a high-school diploma was considered, however, subgroup differences between predicted scores were substantially reduced. Implications of these empirical results for the general problem of military personnel selection are discussed.

Fast, J.C., and Looper, L.T. (1988) Multiattribute decision modeling techniques: A comparative analysis. US AFHRL TR 88-3.

Developed a taxonomy of decision-modeling techniques and performed a comparative analysis of 2 techniques, policy capturing and policy specifying, used by the US Air Force in personnel selection, job classification and promotion decisions.

Finstuen, K., and Alley, W.E. (1983) Occupational and personnel correlates of first-term enlisted tenure in the Air Force. US AFHRL TR 82-36.

Measured the effects of occupational assignment and certain personnel characteristics on first-term enlisted tenure in the Air Force, using 280,039 Air Force enlistees as Ss. Results indicate that attrition rates differ markedly among Air Force Specialty Codes, with the nature of the differences being interactive rather than additive. These findings imply that first term enlisted attrition would be reduced if tenure predictions from personnel characteristic data were made on an occupational specific basis.

Finstuen, K., Weaver, C.N., and Edwards, J.O. (1982) Occupational Attitude Inventory: Use in predictions of job satisfaction, reenlistment intent, and reenlistment behavior. US AFHRL TR 82-21

The Air Force Occupational Attitude Inventory (OAI) was administered to 1,217 1st-term airmen in 1973 and to 4,784 in 1975. Strong positive correlations were found between OAI responses and overall job satisfaction (JS) reenlistment intent, and actual reenlistment behavior. Specific occupational attitudes linked with global JS included job interest, challenge, use of abilities and accomplishment. Cross-application of the least squares regression weights developed on the two samples confirmed the stability of the occupational attitude equations. The OAI would be useful in guiding management activities so as to improve JS, which would in turn result in increased motivation, productivity, and retention.

Fischer, D.G., and Sobkow, J.A. (1979) Workers' estimation of ability requirements of their jobs. Perceptual & Motor Skills, 48(2), 519-531.

A slightly modified version of the Minnesota Job Requirements Questionnaire, representing the General Aptitude Test Battery, was used by Canadian workers in 25 selected jobs to rate the ability requirements of their jobs. Ss' job requirement ratings were compared with experts' ratings in the Canadian Classification and Dictionary of Occupations and with occupational ability patterns derived from the test battery approach. As in previous studies, with few exceptions, high reliability of Ss' job requirement rating was indicated by high alpha coefficients. Comparison of mean ratings and variability of ratings by Ss in jobs with Ss in other jobs demonstrated construct validity for workers' ratings, as did intercorrelations of the ratings. Occupational ability patterns derived from the job rating approach compared favorably with those derived from

the test battery and the expert ratings, suggesting that the more parsimonious job rating approach is a reliable alternative to the other 2. Results support the view that employees in a job can provide reliable information about job requirements.

Fischl, M.A., Ross, R.M., and McBride, J.R. (1979) Development of factorially based ASVAB high school composites. US Army Research Institute TP 360.

The Armed Service Vocational Aptitude Battery (ASVAB) is used for selection and classification purposes by the military services and for vocational guidance in high schools. The present research was designed to improve score composites used for vocational guidance. Factor analysis was used to cluster the scores of 2,052 Ss in Grades 10-12. The data was originally obtained by J. Fletcher and M.J. Ree (1976). A principal factor solution was rotated to simple oblique structure to achieve the following 5 ability factors: Verbal, Analytic/Quantitative, Clerical, Mechanical, and Trade/Technical. These factors have high reliability and relatively low intercorrelations. A final score test composite, Academic Ability, was added to the factorially based composites as an indicator of the ability to succeed at further school or formal training.

Fleishman, E.A., Gebhardt, D.L., and Hogan, J.C. (1984) The measurement of effort. Ergonomics, 27(9), 947-954.

A series of studies examined the reliability and validity of an index of perceived physical effort assessing the metabolic and ergonomic costs of task performance and the particular physical-ability requirements of tasks most related to perceived effort. The studies involved the prediction of metabolic costs by personnel and nonpersonnel specialists, revision of an effort scale, validation of the effort scale, relation of effort to physical disability requirements, and prediction of task performance. Findings support the reliability and validity of the effort index and provide a basis for determining physical requirements of work tasks. The usefulness of the physically demanding work is discussed.

Fleishman, E.A. and Quaintance, M.K. (1984) Taxonomies of human performance: The description of human tasks. Orlando: Academic Press, Inc.

Describes the basic issues involved in taxonomic description of human work and how human task performance can be classified. For behavior description, twelve different methods are given. For behavior requirements, twelve different approaches are discussed. Within the framework of abilities dimensions, several

different taxonomies are noted while for task characteristics taxonomies, five different methods are noted. Detailed attention is given to: the criterion measures approach, the information-theoretic approach, the task strategies approach, the ability requirements approach, and the task characteristics approach.

Fleishman, E.A., and Mumford, M.D. (1989) Individual attributes and training performance. In I.L. Goldstein and Associates. Training and development in organizations. San Francisco: Jossey-Bass Publishers. Chapter 6; pages 183-255.

Reviews literature on individual differences as expressed in abilities, skills, and knowledges and the impact of these differences among people on training outcomes. Stresses the importance of learners' characteristics on learning and training of such variables as aptitudes, reading level, academic motivation, educational level, educational preparation, and age. Discusses at length the Ability Requirements Taxonomy system with 50 ability categories. Describes how to link abilities and job/task requirements and how to use ability requirements in training, skill acquisition, training system design, and training research.

Friedman, L., and Harvey, R.J. (1986) Can raters with reduced job descriptive information provide accurate Position Analysis Questionnaire (PAQ) ratings? Personnel Psychology, 39(4), 779-789.

Suggests that A.P. Jones et al stated that job-naive raters provided with only narrative job descriptions can produce valid and reliable PAQ ratings. To determine the convergent validity of the Jones et al approach, the present authors provided job-naive raters (180 undergraduates) with varying amounts of job descriptive information and, in some cases, prior practice rating the job with another job analysis instrument; PAQ ratings were validated against those of 3 job analysts who were also job content experts. Results indicate that none of the reduced job descriptive information conditions (or the practice) enabled job-naive raters to obtain either acceptable levels of convergent validity with experts of high interrater reliability.

Gawron, V.J., Drury, C.G., Czaja, S.J., and Wilkins, D.M. (1989) A taxonomy of independent variables affecting human performance. International Journal of Man-Machine Studies, 31, 643-672.

Presents a taxonomy of human performance and discusses its development. The new taxonomy followed the review of existing taxonomies and was based on a selection of 18 taxonomies

appearing during a span of 25 years (1961-1986). The 18 source taxonomies are presented; they range from 3 elements at the briefest to 165 at the most. The source taxonomies differed in focus and intent as well as level of abstraction. Gawron et al. merged the 18 existing taxonomies into one derivative taxonomy. The new taxonomy is called "Human's taxonomy" because it was developed for use in conjunction with the Human Performance Expert System. Identical or synonymous words in the existing taxonomies were used as the connection between taxonomies. Independent variables used in studies (such as type of environment, gender, and age) were then added, redundant variables were removed, and ambiguous variables were renamed. Finally, human factors engineers reviewed the result "for clarity and completeness," and more variables were added. The final "Human" taxonomy includes 325 subdivisions. Companion and Corso's 11-item criteria for taxonomies are noted but not applied or discussed.

Gottfredson, L.S. (1986) Occupational Aptitude Patterns Map: Development and implications for a theory of job aptitude requirements. Journal of Vocational Behavior, 29(2), 254-291.

Used US Employment Service data on the cognitive and noncognitive aptitude requirements of different occupations to create an occupational classification--The Occupational Aptitude Patterns Map (OAPM)--of 13 job clusters arrayed according to major differences in overall intellectual difficulty level and in functional focus (field) of work activities. The OAPM was compared with an alternative, aptitude-based classification; with J.L. Holland's (1985) typology of work environments; and with ratings for complexity of involvement with data, people, and things. Those comparisons supported the construct validity of different aspects of the OAPM and helped clarify uses for which it is most appropriate. It is concluded that when combined with previous evidence about patterns of job aptitude demands, the OAPM provides the basis for a theory of job aptitude requirements. The OAPM and accompanying analyses support the following hypotheses: (1) General Intelligence is the major gradient by which aptitude demands have become organized across jobs in the US economy; (2) within broad levels of work, the aptitude demands of different fields of work differ primarily in the shape of their cognitive profiles; and (3) different aptitude demand patterns arise in a large part from board differences in the tasks workers actually perform on the job.

Grafton, F.C., and Horne, D.K. (1985) An investigation of alternatives for setting second-to-third tour reenlistment standards. US Army Research Institute TR 690.

Examined job performance, as measured by the Skill Qualification Tests, among US Army re-enlistees in relation to scores on 3 measures from the Armed Services Vocational Aptitude Battery-the Armed Forces Qualifications Test, General Technical, and Aptitude Area composites. All aptitude scales were significantly related to performance across military occupational specialties and skill levels. The specific Aptitude Area composites generally predicted performance better than the other 2 measures.

Hackman, J.R. (1980) Work redesign and motivation. Professional Psychology, 11(3), 445-455.

The redesign of jobs and work systems is frequently carried out to increase organizational productivity and/or to improve the quality of the work experience of organization members. Four theoretical approaches to work redesign (activation theory, motivation-hygiene theory, job characteristics theory, and the sociotechnical theory) are reviewed and compared, and the kinds of personal and work outcomes that can reasonably be expected from restructuring jobs are discussed. A number of unanswered questions (e.g., the role of individual differences, diagnostic and evaluation methodologies, and the job of the supervisor) about the strategy and tactics of redesigning jobs are presented, and some problems in installing work redesign programs in existing organizations are outlined.

Hanser, L.M. Birnbaum, A., and Bauman, R. (1989) Predicting task based performance with measures of personal temperament. Paper presented at 97th Annual Convention, American Psychological Association. New Orleans.

Measures of cognitive ability have long proven to be the best predictors of performance. The Army is interested in identifying lower ability applicants who achieve higher levels of performance than would be predicted by their cognitive ability. Our aim is to identify variables which may add to the predictive power of general cognitive ability. Among soldiers, two personal temperament constructs, Work Orientation and Dependability, were found to be equally if not more important than cognitive ability alone in predicting job performance. Further, these personal temperament variables predict not only motivational but also task-related aspects of performance. Such findings suggest that performance on technical tasks is a product of both cognitive ability and personal temperament, a conclusion which has definite implications for selection as well as training.

Harman, J. (1984) Three years of evaluation of the Army's Basic Skills Education Program. US Army Research Institute RR 1380.

Summarizes 3 years of evaluation research on the US Army's Basic Skills Education Program, which provides enabling skills in literacy, language, arithmetic, computation, and speaking. Analyses of standard, pilot, and revised programs as well as programs under development are described. Overall findings reveal that all programs tend to move participants in the direction of Army goals, although a substantial number of soldiers fail to meet program criteria. Factors that may dilute program effectiveness include teachers' lack of specialized training, the wide range of skill levels within classes, and personnel turbulence.

Harvey, R.J. (1986) Quantitative approaches to job classification: A review and critique. Personnel Psychology, 39(2), 267-289.

Reviews the steps involved in using different quantitative job classification methods and in translating their output into personnel actions, focusing on descriptive techniques concerned with using an exploratory approach to uncovering positions vs inferential techniques that use statistical significance tests of job differences. Descriptive techniques include hierarchical clustering analysis and dimensional techniques such as rotated, exploratory factor analyses and nonmetric multidimensional scaling. Inferential techniques include repeated-measures analysis of variance (ANOVA) and canonical correlations. Guidelines for selecting a quantitative grouping technique are discussed.

Harvey, R.J., Billings, R.S., and Nilan, K.J. (1985) Confirmatory factor analysis of the Job Diagnostic Survey: Good news and bad news. Journal of Applied Psychology, 70(3), 461-468.

Conducted confirmatory tests of the factor structure of the Job Diagnostic Survey (JDS), using data obtained from 2,028 National Guard employees. Neither the Hackman-Oldham nor single-factor models provided acceptable fit until construct-irrelevant method variance factors were added. After incorporating method factors, the confirmatory factor analyses supported Hackman and Oldham's prior structure; however, when a different goodness-of-fit measure was used, a general factor model was more parsimonious.

Harvey, R.J., and Hayes, T.L. (1986) Monte carlo baselines for interrater reliability correlations using the Position Analysis Questionnaire. Personnel Psychology, 39(2), 345-357.

Performed a Monte Carlo study that varied the number of raters as well as the number of "does not apply" (DNAP) rating agreements to facilitate the interpretation of the Position Analysis Questionnaire (PAQ) interrater reliabilities. To estimate the worst possible reliability that could be expected for a given DNAP agreement level, the remaining non-DNAP ratings were random numbers. Results show that reliabilities in the .50 range were obtained when raters ruled out only 15-20% of the items as DNAP and responded randomly to the remainder. Results provide additional evidence against the use of untrained or relatively job-naive raters to complete the PAQ in actual job analysis applications.

Harvey, R.J., and Lozada-Larsen, S.R. (1988) Influence of amount of job descriptive information on job analysis rating accuracy. Journal of Applied Psychology, 73(3), 457-461.

Some research has suggested that Position Analysis Questionnaire (PAQ) ratings made by analysts who have only cursory job descriptive information are functionally identical with those of job experts. Our goals were to examine whether (a) previous claims regarding the comparability of job-naive and expert analysts generalize to non-PAQ tasks, (b) subcomponents of job analysis accuracy are similarly affected by job information, and (c) the presence of a job title alters the effect of job information on accuracy. Two hundred eighty-one naive raters evaluated 11 insurance jobs on 36 task-oriented dimensions using only the title, a job description without title, or both title and description. The Cronbach (1955) procedure was used; average incumbent ratings served as the standard. Our results indicate that (a) job information strongly influences differential accuracy and, to a lesser extent, differential elevation and the stereotype accuracy correlational subcomponent; (b) job information has little effect on elevation stereotype accuracy, and the differential elevation correlation; (c) the presence of a job title is not sufficient to trigger the use of job stereotypes; and (d) none of the reduced-information groups were accurate enough to substitute for content experts.

Heller, F. (1989) On humanizing technology. Special issue: Coping with new technology. Applied Psychology: An International Review. 38(1), 15-28.

Discusses the incongruities of beneficial and damaging consequences of new technology. It is suggested that although technology itself is probably neutral, grave sociopsychological and ethical problems may arise if the technological imperative combined with an untrammelled open market is allowed to operate. Two irreconcilable notions about technology are discussed. One supports the view that technology must be designed to maximize its efficiency on a cost-benefit basis. This notion assumes that the human component, which has to work with the technology, is always capable of adapting successfully to it. The 2nd notion is that the human-technology adaptation cannot be taken for granted. The theoretically "best technical solution" will often fail to produce an optimum overall result. It is concluded that the blending of the relationship between technology and the people who have to use it can be approached using a sociotechnical framework.

Henriksen, K.F., et al. (1980) Identification of combat unit leader skills and leader-group interaction processes. US Army Research Institute TR 440.

After a review of literature on leader skills and processes in tactical settings, a listing of leader skill categories and individual leader skills, which was arrived at inductively by analysis of audio-tapes and battle narratives, is presented. The list includes individual skills involved, thus providing a general skill category under which the individual skills are subsumed. Categories found in the literature (e.g., initiating structure) that consisted of the same skills were adopted, but many of the skill categories did not have identical counterparts. The 5 broad skill categories were (a) management skills-planning, execution and control, initiating structure, and interacting with subordinates and superiors; (b) communications skills-transfer of information, and pursuit and receipt of information; (c) problem-solving skills-identification and interpretation of cues, weighing alternatives, and choosing a course of action; (d) tactical skills-application; and (e) technical skills-equipment and basic.

Hollenbeck, J.R., Brief, A.P., Whitener, E.M., and Pauli, K.E. (1988) An empirical note on the interaction of personality and aptitude in personnel selection. Journal of Management, 14,(3), 441-451.

Investigated whether measures of personality traits, recognized as poor predictors of job performance, might serve as

useful screening devices when used in conjunction with aptitude tests. 130 undergraduates completed assessments of self-esteem and locus of control. These scores were compared with Ss' Scholastic Aptitude Tests results. 48 salespersons completed an aptitude battery and measures of locus of control and self-esteem. Results indicate that self-esteem interacted with aptitude to predict future performance of life insurance salespersons and that locus of control interacted with aptitude to predict performance for undergraduates.

Horne, D.K. (1986) The impact of soldier quality of performance in the Army. US Army Research Institute TR 708.

Presents findings from a multivariate regression analysis of the relationship between soldier performance and Armed Forces Qualification Test (AFQT) scores. Explanatory variables included the AFQT variable, sex, race, education, experience, and training. Findings indicate that AFQT scores, a measure of trainability, are a significant predictor of performance in the US Army. No other variables were consistently significant across all military occupational specialities. Information on how much additional performance on the average is associated with an increase in AFQT scores can be used to support personnel resource utilization and recruiting policies.

Hunter, J.E. (1986) Cognitive ability, cognitive aptitude, job knowledge, and job performance. Journal Vocational Behavior, 29(3), 340-362.

A Research review indicates that general cognitive ability (GCA) predicts supervisor ratings and training success as well as objective, rigorously content-valid work sample performance. Path analysis carried out in several previous studies by the present author showed that much of this predictive power stemmed from the fact that GCA predicted job knowledge and job knowledge predicted job performance. However, GCA predicted performance to a greater extent, verifying job analyses showing that most major cognitive skills are used in everyday work. Evidence showing that it is GCA and not specific cognitive aptitudes that predict performance is discussed. Findings support classic learning theory over behaviorist theories of learning and performance.

Hunter, J.E., and Hunter, R.F. (1984) Validity and utility of alternative predictors of job performance. Psychological Bulletin, 96(1), 72-98.

Meta-analysis of the cumulative research on various predictors of job performance showed that for entry-level jobs there was no predictor with validity equal to that of ability,

which had a mean validity of .53. For selection on the basis of current job performance, the work sample test, with mean validity of .54, was slightly better. For federal entry-level jobs, substitution of an alternative predictor would cost from $3.12 (job tryout) to $15.89 billion/year (age). Hiring on ability had a utility of $15.61 billion/year but affected minority groups adversely. Hiring on ability by quotas would decrease utility by 5%. A 3rd strategy-using a low cutoff score-would decrease utility by 83%. Using other predictors in conjunction with ability tests might improve validity and reduce adverse impact, but there is as yet no database for studying this possibility.

Johnson, E.M., Spooner, R.L., and Jaarsma, D. (1977) The perception of tactical intelligence indications by intelligence officers. US Army Research Institute. TP 278.

Assessed the effectiveness of traditional tactical indications in analyzing conventional military operations by having 46 US Army captains assume the role of intelligence analyst in an infantry division conducting a mobile defense action. Each S estimated the probability that each of 49 indications would occur, given the aggressor's known course of action. Each indication was evaluated with each course of the 4 general courses of enemy action-attack, defend, delay, and withdraw. 11 indications were evaluated twice with each course of action to provide an estimate of reliability. The estimates of probability made by Ss were highly reliable. However, the variability in the Ss' estimates for the same indication was extremely high, with an average range of estimates greater than .7 on a 0 to 1.0 scale. It is concluded that the traditional indications of enemy operations are either poorly understood or are intrinsically inadequate for use in contemporary intelligence operations.

Kantor, J.E., and Bordelon, V.P. (1985) The USAF pilot selection and classification research program. Aviation, Space & Environmental Medicine, 56(3), 258-261.

Describes a program to improve the selection of US Air Force (USAF) pilot trainees and the classification of student pilots for either fighter or heavy aircraft training. A battery of experimental tests measuring psychomotor skills, personality traits, and cognitive abilities is being given via computer prior to training. Ss' performance in training and operational flying is then tracked and analyzed. Preliminary results from 1,622 Ss and future directions of this program are discussed.

Kass, R.A., Mitchell, K.J., Grafton, F.C. and Wing, H. (1983) Factorial validity of the Armed Services Vocational Aptitude Battery (ASVAB), Forms 8, 9, and 10: 1981 Army applicant sample. Educational & Psychological Measurement, 43(4), 1077-1087.

98,689 US Army applicants completed ASVAB. Factor analysis yielded 4 orthogonal factors accounting for 93% of the total variance: Verbal Ability, Speeded Performance, Quantitative Ability, and Technical Knowledge. Factor analyses of male, female, White, Black and Hispanic subgroups yielded similar results. Findings provide evidence of the replicability of ability constructs across diverse samples.

Katter, R.V., Montgomery, C.A., and Thompson, J.R. (1979) Human processes in intelligence analysis: Phase I overview. US Army Research Institute RR 1237.

Presents a general descriptive model of the cognitive activities (mental processes) underlying intelligence analysis. The approach combines information in the way in which intelligence analysis is performed in actual work settings with research findings in cognitive psychology. To investigate analytical processing as currently practiced in 2 types of single-source analyses and to generalize to multi-source analysis, an initial interview and observation field study evaluated signal intelligence. A 2nd field study which investigated imagery intelligence (IMINT), resulted in a model of the directly observable activities of single-source IMINT production. A questionnaire interview guide was also developed and used to study the 2 single-source disciplines and multi-source production activities. Based on a review of literature in cognitive psychology, a cognitive model was developed to assess intelligence analysis activities. Overall findings indicate that effective intelligence analysis is a concept-driven activity rather than a data-driven one.

Kavanagh, M.J., Borman, W.C., Hedge, J.W., and Gould, R.B. (1987) Job performance measurement in the military: A classification scheme, literature review, and directions for research. US AFHRL TR 870-15.

Describes the construction of a job performance measurement classification scheme into which relevant empirical and theoretical literature are organized, with emphasis on its applicability in a military context. Measurement methods are based on supervisory ratings, peer ratings, self ratings, objective indices of productivity, and observer interviewing. Individual characteristics and rater-relationships are discussed, as are performance standards and variables involved in the evaluation process.

Lane, N.E. (1987) Skill acquisition rates and patterns. New York: Springer-Verlag.

Reviews recent research work on skill acquisition rates and patterns. The primary purpose of this review is to relate skill acquisition to appropriate training courses or modules. Skill acquisition rates should help in establishing the best amount of training for a student. Therefore, it is important to examine the time variables in skill acquisition, i.e., what happens to performance over time. In short, the overall objective of this analysis was to look for lawful relationships between characteristics of the training environment and method of training and the degree of useful learning attained at various periods in the training process.

Lee, J.A., and Mendoza, J.L. (1981) A comparison of techniques which test for job differences. Personnel Psychology, 34(4), 731-748.

Explored the most appropriate technique for determining job similarities/differences by using Monte Carlo methods to analyze the repeated measures ANOVA and MANOVA. The conventional univariate ANOVA, the E-adjusted univariate F test, and the E-adjusted univariate F test were compared to 3 multivariate tests in terms of power and control for Type I error when (1) circularity and homogeneity were met, (2) homogeneity was met but circularity was violated, (3) homogeneity was violated but circularity was met, and (4) both homogeneity and circularity were violated. The univariate test proved to be the better technique when circularity was met. The mulitvariate technique proved to be the better test when homogeneity was met while circularity was violated. Results are mixed when both circularity and homogeneity were violated.

Lee, R., and Foley, P.P. (1986) Is the validity of a test constant throughout the test score range? Journal of Applied Psychology, 71(4), 641-644.

Studied the effect of the magnitude of the mean predictor score on the validity coefficient, corrected for range restriction due to explicit selection, from 68,672 Navy recruits. The predictor was the Armed Forces Qualification Test (AFQT) and the criteria were 6 non-AFQT tests of the Armed Services Vocational Aptitude Battery: General Science, Coding Speed, Auto and Shop Information, Mathematics Knowledge, Mechanical Comprehension, and Electronics Information. It is concluded that (a) the validity coefficients were generally higher at higher predictor score ranges and (b) the validity, slope and standard

error of estimate should be viewed as an average rather than a constant value for all Ss in a population.

Lee, R., and Klein, A.R. (1982) Structure of Job Diagnostic Survey for public sector occupations. Journal of Applied Psychology, 67(4), 515-519.

Investigated the factor structure of the Job Diagnostic Survey (JDS) for 1,632 public sector employees. The JDS measured skill variety, task identity, task significance, autonomy, and feedback for state and county government employees who were administrators, professionals, technicians, paraprofessionals, clericals, and service and technical workers. In general, matrices supported the dimensionality of the JDS. However, for technicians and service and maintenance workers, 2 items designed to tap autonomy had higher loadings on the feedback, task identity, task significance, and skill variety factors.

Levine, E.L., Ash, R.A., and Bennet, N. (1980) Exploratory comparative study of four job analysis methods. Journal of Applied Psychology, 65(5), 524-535.

Four job analysis methods--job elements, critical incidents, the Position Analysis Questionnaire (PAQ), and task analysis--were empirically compared to assess their utility for personnel selection. Four job classifications were analyzed with each of the job analysis methods, yielding 16 separate reports. 64 government personnel selection specialists were assigned to each of the cells in the 4 by 4 design. Each S evaluated 1 report, developed an examination plan from it and evaluated that plan. Occupational experts and researchers independently evaluated the exam plans, and exam plan contents were quantified for separate analysis. Results reveal that although the PAQ was the least costly method to apply, participants rated PAQ reports lowest. The critical incidents method resulted in examination plans that appeared to be somewhat higher in quality than plans derived from other methods. The methods, however, had relatively little impact on exam plan contents or the costs of developing exam plans.

Mallamad, S.M., Levine, J.M., and Fleishman, E.A. (1980) Identifying ability requirements by decision flow diagrams. Human Factors, 22(1), 57-68.

The development and evaluation of a new method for the identification of ability requirements of jobs is described. The method developed is based on current knowledge about human abilities and utilizes flow diagrams as a decision aid. An

analyst systematically proceeds through a series of binary decisions as to whether or not each of 40 abilities is required for performing a job or task. Three studies evaluated the reliability of the technique for different samples of analyst and types of job description. A comparison was made with an alternate approach using rating scales to assess abilities in the same tasks and jobs. The decision flow diagrams proved to be reliable and superior to the rating scale approach for identifying abilities. The diagrams seem best employed in conjunction with the rating scales, the former to identify required abilities and latter to quantify the degree of involvement of each of the identified abilities. The diagrams and rating scales appear to provide a feasible technique to help establish personnel requirements for jobs.

Mathews, J.J., Valentine, L.D. and Sellman, W.S. (1978) Prediction of reading grade levels of service applicants from Armed Services Vocational Aptitude Battery (ASVAB). US AFHRL TR 78-82.

Assessed the reading ability of US military service applicants and accessions and studied the relationship between ASVAB measures and reading scores. 2,432 Ss took the ASVAB and the Gates-MacGinitie Reading Tests, Survey D (GM); 818 of these Ss also took the Nelson-Denny Reading Test (ND). Ss' median reading grade levels (RGLs) were 9.0 on the GM and 9.5 on the ND. The median GM RGL of Ss who qualified for services was 10.2 compared to 5.7 for nonqualified applicants. The Armed Forces Qualification Test correlated .76 with the average of RGLs for the 2 reading tests. The ASVAB General Technical composite (General Aptitude Index for Air Force) correlated .79 with average RGL. It is recommended that GT be used as an index of RGL for military service applicants.

McEvoy, G.M., and Cascio, W.F. (1985) Strategies for reducing employee turnover: A meta-analysis. Journal of Applied Psychology, 70(2), 342-353.

Investigated the relative effectiveness of realistic job previews (RJPs) and job enrichment as turnover reduction strategies. A thorough literature search located 20 experiments (N = 6,492 Ss) dealing with attempts to reduce turnover in field settings. Several meta-analysis techniques showed that variation in the outcomes of job enrichment studies can be attributed to sampling error alone, whereas variation in the outcomes of RJP studies cannot. A search for moderators in the latter case revealed moderate support for the notion that task complexity affects RJP outcomes. Furthermore, the meta-analyses indicated that job enrichment interventions are about twice as effective at

reducing turnover as RJPs. Based on the calculated effect sizes, estimates of savings from turnover reductions are provided.

McFann, Gray & Associates, Inc., (1989). Taxonomic Work Station: User Guide (Draft). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

McLaughlin, D.H., et al. (1984) Validation of current and alternative Armed Services Vocational Aptitude Battery (ASVAB) Area Composites, based on training and Skill Qualification Test (SQT) information for fiscal year 1981-1982 enlisted accessions. US Army Research Institute TR 6-51.

Conducted a large scale research effort to validate and improve the ASVAB aptitude area (AA) composites now used by the US Army to select and classify enlisted personnel. Data were collected from existing Army sources on approximately 94,000 soldiers and over 60 training and skills cells. The research had 3 major components: (1) the composites now being used by the Army were validated, (2) a new set of composites was derived empirically, (3) both sets were compared on the basis of predictive validity, differential validity, and possible prediction bias. Both sets of composites were found to perform well, with the alternative set of 4 composites doing slightly better than the 9 now in operational use. Appendices contain supplemental tables, editing of training outcomes, and conversions of scores.

Milton, M.S., Patten, S.M., and Halpin, S.M. (1980) The structure of combat intelligence ratings. Catalog of Selected Documents in Psychology, 10, 54. MS. 2075.

Mitchell, K.J. (1983) Cognitive processing determinants of item difficulty on the verbal subtests of the Armed Services Vocational Aptitude Battery. US Army Research Institute TR 598.

Identified the cognitive processing operations and strategies involved in performance on the verbal subtests of the Armed Services Vocational Aptitude Battery (ASVAB). Cognitive processes thought to underlie performance on the Word Knowledge and Paragraph Comprehension subtests were identified and items on 2 ASVAB forms were rated on these variables over 80 rater hours. The relative effects of cognitive processes were examined for 8 groups of Army applicants and accessions, involving 6,671 Ss, using linear latent logistic trait methods. Analyses demonstrated the relevance of cognitive processing variables to item difficulty for the ASVAB verbal items.

Modjeski, R.B., and Michael, W.B. (1978) The relationship of the General Educational Performance Index measure to other indicators of educational development in each of three samples from an United States Army population. Educational & Psychological Measurement, 38(2), 377-391.

For each of 3 samples of 223, 124 and 54 individuals (enlisted US Army personnel) representing military populations of different ability levels, relationships were found between total (mean) scores on achievement examination batteries or on their subtests and corresponding scores on a relatively new test battery entitled General Education Performance Index (GEPI), a comparatively short examination with 5 subtests essentially parallel in content 5 subtests of the General Educational Development (GED) test battery that requires about 10 hrs to administer. Although composite (mean) scores on the GED test battery could be predicted with a relatively high degree of accuracy from those on the GEPI composite (the correlations varying between .52 and .70), scores on one subtest in either battery could be forecast from those in corresponding subtest in the other battery with somewhat limited accuracy (the correlations ranging from .28 to .57). Subtests in Reading and Language of the Comprehensive Tests of Basic Skills provided coefficients falling between .40 and .68 in relation to composite scores on the GED and GEPI test batteries, whereas the Nelson Reading Test and the General Technical Composite Score of the Armed Services Vocational Aptitude Battery furnished, respectively, corresponding coefficients ranging between .01 and .30 and between .12 and .36.

Moore, N.K., Safter, M.T., and Siefert, R.F. (1985) Basic skill requirements for selected Army occupational training courses. Contemporary Educational Psychology, 10(1), 83-92.

Obtained judgments of 126 instructors from 25 military occupational specialties on 129 candidate skills needed by soldiers before they enter the US Army. Judgements resulted in the identification of 55 basic cognitive skills. Factor analysis resulted in 11 interpretable factors. When mean scores for the factors were compared across factors and across Army training schools, the results show that skills related to the learning process were as crucial as traditional academic skills for successful training course completion. It is suggested that training modules incorporate learning-to-learn components in their curriculum.

Muckler, F.A. (1987) The human-computer interface: The past 35 years and the next 35 years. In G. Salvendy (Ed.). Cognitive engineering in the design of human-computer interaction and expert systems. Amsterdam: Elsevier Science Publisher. Pages 3-12.

In 1950, the human-computer interface was completely different than the one we see today--certainly "simpler" but far less effective. Today, we are seeing a transition phase where nothing is working very well, but the possibilities are exciting. Some of our current problems are illustrated by four examples. Many significant changes will occur in the next 35 years, and perhaps the most important from the human-computer interface standpoint will be voice interactive systems. For future systems, eight basic questions are suggested.

Naughton, T.J. (1988) Development and test of an occupational taxonomy based on job characteristics theory. Journal of Vocational Behavior, 32(1), 16-36.

Developed a new classification of occupations based on the degree of variety, identity, autonomy, significance, and feedback--major job characteristics often identified with the motivational potential of jobs. Based on 2 randomly drawn samples from 1,515 respondents in the Quality of Employment Survey (R. Quinn and G. Staines, 1979), a cluster analysis revealed 10 relatively homogeneous clusters of jobs across both samples. Additional analysis suggested further support for the taxonomy when between-cluster differences appeared to explain the relationship between the job characteristics and job satisfaction, organizational size, and prestige while within-cluster effect for these same variables were nonsystematic.

Neff, K.L., and Solick, R.E. (1983) Military expert's estimates of continuous operations performance (or close but no cigar). US Army Research Institute TR 600.

Studied the feasibility of supplementing human performance data used in land combat models with estimates of solider performance in adverse environments. Detailed descriptions of 3 performance tests (tank crews performing simulated combat tasks over a 48 hr period, fire-direction-center teams undergoing up to 48 hrs of simulated sustained combat operations, and parachute platoons performing a sustained tactical defensive exercise in the UK for up to 5 days without sleep) and average scores or times for the 1st time period were given to 29 US Army officers who were students at a staff school. Ss were asked to estimate the scores for the 2nd, 3rd, and 4th periods. Findings show that Ss agreed among themselves in their predictions of performance by high intraclass correlations. Ss' predictions did not reflect

actual performance measures obtained in the original exercises. Ss' estimates were no more accurate for performance after 12 hrs than 24 hrs, 25, or 48 hrs of continuous operations. Ss' predictions were more accurate for cognitive and vigilance tasks than for simple motor tasks. Caution is necessary in using expert ratings, even in cases of strong agreement among raters. Predicted performances on 40 military tasks are appended.

Nieva, V.F., Myers, D., and Glickman, A.S. (1979) An exploratory investigation of the Skill Qualification Testing System. US Army Research Institute TR 390.

Conducted semistructured interviews with 52 US army enlisted personnel to provide information on user reaction to the various components of the Skill Qualification Testing (SQT) system: the Soldier's Manual, the SQT Notice, and the test itself. Results indicate that instructors used the Soldier's Manual most, while the enlisted personnel used the manuals primarily for reference. Soldiers who realized the function of the SQT Notice found it useful. Reaction to the SQT was generally favorable, although test-related problems were identified. More soldiers who had formal training for SQT reported passing the test than soldiers who had prepared for the test on their own.

Oxford-Carpenter, R.L., and Schultz-Shiner, L.J. (1984) A theory-based approach to reading assessment in the Army. US Army Research Institute TR 625.

Addresses practical US Army problems in reading assessment from a theory base that reflects the most recent and, it is suggested, the most sound research on reading comprehension. Six major conclusions are drawn from both theory and practice. First, reading is important in military and civilian work life. Second, reading assessment is a highly visible and important issue in the Army. Third, reading theories--especially the new interactive-inferential theory--can positively influence reading measurement practices in the Army. Fourth, reading tests are not all alike; they differ widely in terms of psychometric characteristics and overall quality as evaluated using theory-based standards. Fifth, high correlations exist between the Armed Services Vocational Aptitude Battery (ASVAB) and various reading tests, although caution needs to be exercised in using any part of the ASVAB as reading-test surrogate. Sixth, alternatives to grade equivalent scores are available and should be considered for Army use.

Parcel, T.L., and Mueller, C.W. (1983) Occupational differentiation, prestige, and socioeconomic status. Work & Occupations., 10(1), 49-80.

Uses factor analysis on numerous occupational skill and task characteristics to determine dimensions of occupational differentiation that are both cognitive (complexity, clerical aptitude, people-things, and uncertainty) and noncognitive (physical activity, physical dexterity, and unpleasantness of working conditions). These dimensions are discussed in relation to theories concerning occupational labor markets and relevant empirical literature. Regression analyses of the Duncan Socieconomical Index and Siegel Prestige Scale on these dimensions suggest that complexity is the most important task determinant of both dependent variables.

Passmore, W.A. (1982) Overcoming the roadblocks in work-restructuring efforts. Organizational Dynamics, 10(4), 54-67

In defining work-restructuring techniques, the author notes that they involve changes in technology, organizational structure and policies, management styles, or job design that are intended to motivate workers and to help them take more responsibility for the products of their efforts. The factors present in successful work-restructuring programs and the roadblocks (e.g., sociopolitical factors) reported in unsuccessful ones are discussed.

Patrick, J., and Moore, A.K. (1985) Development and reliability of a job analysis technique. Journal of Occupational Psychology, 58(2), 149-158.

Discusses reliability issues associated with the development of a job analysis technique--the Job Structure Profile. Interrater reliability, measured by intraclass correlation, and retest reliability were calculated from the job elements of a sample of 9 clerical, secretarial, and managerial jobs. Eight raters, comprised of 4 job incumbents and 4 supervisors, were used for each job group and were interviewed twice at least 6 weeks apart. There was no difference in interrater or retest reliability between supervisors and job incumbents. The effect of different mixes of incumbents and supervisors on interrater reliability was calculated, and satisfactory levels were achieved with 4-5 raters.

Pearlman, K. (1980) Job families: A review and discussion of their implications for personnel selection. Psychological Bulletin, 87(1), 1-28.

Reviews the personnel literature on the development of job families and discusses the implications for personnel selection. Job family development is viewed as essentially a matter of behavior classification in the world of work. Accordingly, the review focuses on the basic taxonomic issues of objective, content, and method in job family construction. The discussion section explores the implications for several related objectives in personnel selection, all of which reflect different aspects of the broader objective of generalizing selection procedure validity. It is concluded that the approaches to developing job families that emphasize either the human attribute requirements or broad content structure of jobs are likely to prove more useful for both theory development and practical application in personnel selection than are approaches based on more molecular analyses of jobs.

Pearson, J.E., and Pearson, C.E. (1985) The effects of bandwidth compression and image quality on image interpreter performance. Human Factors, 27(3), 345-353.

Investigated the possible interactive properties of transmission bandwidth reduction and imagery quality on the interpretability of digital electro-optical imagery displayed in soft-copy format on CRTs. 15 US Army image interpreters were tested in a field-deployed image interpretation facility. Their performance was evaluated in terms of completeness of classification and identification of military equipment, accuracy of equipment counts, and speed of interpretation. Results indicate that greater bandwidth compression and/or low image quality significantly degraded interpreter performance.

Peterson, N.G. (Ed) (1987) Development and field test of the Trial Battery for Project A. US Army Research Institute TR 739.

Findings from an extensive literature review, expert judgements on validity of measures identified in the review, and administration of a preliminary battery of "off-the-shelf" measures guided the development of new tests to complement the Armed Services Vocational Aptitude Battery in predicting soldiers' job performance. After iterative pilot tests and revisions, the measures were field tested. Analysis indicated the new tests had adequate to excellent psychometric qualities, were relatively unique, and were not unduly affected by practice or by faking in an applicant setting. The resulting battery contains 6 cognitive paper-and-pencil tests; 10 computer-

administered perceptual/psychomotor tests; and 2 paper-and-pencil inventories that address temperament, biographical data and interests.

Peterson, N.G., and Bownas, D.A. (1982) Skill, task structure, and performance acquisition. In M.D. Dunnette and E.A. Fleishman (Eds.) Human performance and productivity: Human capability assessment. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers. Chapter 3, pages 49-105.

For the effective allocation of human resources assumes the need for a job-requirements matrix relating job/task dimensions with human characteristics such as abilities, attributes, knowledges, experience, aptitudes, proficiencies, personality orientations, and so forth. Reviews previous methods of job/task taxonomies and human-characteristics taxonomies. Constructs a 51-dimension human-characteristics taxonomy including cognitive abilities (12), psychomotor and physical fitness abilities (18), personality dimensions (15), and vocational preference dimensions (6). Discusses how a job-requirements matrix can be built by linking job/task and human-characteristics taxonomies.

Phelps, R.H., Englert, J.A., and Mutter, S.A. (1984) Application of a cognitive model for Army training: Handbook for strategic intelligence analysis. US Army Research Institute TR 654.

Presents the end-product of a research effort on the cognitive skills involved in performing intelligence analysis, the Handbook for Strategic Intelligence Analysis. The background research into the thinking processes of intelligence analysis and the resulting descriptive cognitive model of analysis are discussed. The handbook is appended and its development is described.

Pierce, J.L., and Dunham, R.B. (1978) The measurement of perceived job characteristics: The Job Diagnostic Survey versus the Job Characteristics Inventory. Academy of Management Journal, 21(1), 123-128.

Data from 155 employees in an insurance company show the Job Characteristics Inventory to be superior to the Job Diagnostic Survey (JDS) in regard to internal consistency and empirical dimensionality. It is noted, however, that the utility of the JDS in job design research has been clearly demonstrated; perhaps the optimal approach for job design researchers focusing on perceived job characteristics is the use of multiple methods.

Prediger, D.J. (1987) Validity of the new Armed Services Vocational Aptitude Battery Job Cluster scores in career planning. Career Development Quarterly, 36(2), 113-125.

Tested the validity of the Armed Services Vocational Aptitude Battery, Form 149 (ASVAB-14) composites and the validity of new ASVAB-14 Job Cluster Scales developed by the American College Testing Program for use in the computer-based career planning system called DISCOVER. 1,109 high school students were tested. The 6 ASVAB-14 Job Cluster Scales, which parallel J.L. Holland's (1985) 6 occupational groups, combine ASVAB-14 composites with self-estimates of other abilities. It is concluded that the ASVAB-14 has serious limitations for career counseling and that counselors should use the ASVAB-14 Occupational Composites with extreme caution, if at all.

Prediger, D.J. (1989) Ability differences across occupations: More than g. Journal of Vocational Behavior, 34(1), 1-27.

Examined the "g supposition"--that general cognitive ability (g) is sufficient as descriptor of work-relevant abilities--and found that it is insufficient. Evidence that g is a superior predictor of job performance is challenged in a discussion of 34 studies showing that the performance criteria predicted by g have little relationship to performance criteria based on measures of job knowledge and work task proficiency. Several studies showing work-relevant differences in the ability patterns of occupations are cited. The author conducted new research on the relevance of 14 cognitive and noncognitive abilities to 6 jobs clusters spanning the work world. Assignments of abilities to job clusters were largely confirmed by job-analysis-based ability ratings for the 12,099 occupations in the Dictionary of Occupational Titles (1977).

Rigg, K.E., Gray, B.B., McFAnn, H.H., and Harden, J.T. (1985) Task taxonomic database system for task analysis and identification of core abilities. Los Angeles, CA: Eaton Corporation Analytical Assessments Center TR-33202, US Army Contract MDA903-84-C-0449.

The objective of this research was to develop a core of generic complex cognitive abilities required to perform a representative set of critical Army tasks. The purpose of this report is to specify a taxonomic system of human performance combined with a research methodology and database system. The approach involves the development of a taxonomy of representative critical Army tasks, the development of a taxonomic system of generic complex cognitive abilities, and the development of a methodology for linking the taxonomies. The design focuses on the development and implementation procedures of a classification system that uses conformal mapping to link tasks with abilities.

Roberts, K.H., and Glick, W. (1981) The job characteristics approach to task design: A critical review. Journal of Applied Psychology, 66(2), 193-217.

Reviews the development of the job characteristics approach of J.R. Hackman and E.E. Lawler and of Hackman and G.R. Oldham to task design and evaluates subsequent research relevant to that model. Theoretical statements of the model are not considered entirely clear, the associated empirical work is seen to frequently fail to test the relations discussed, and adequate multimethod instruments were not found for the assessment of several constructs. It is suggested (1) that future task design research should attend to alternative theoretical perspectives that distinguish between situational attributes of tasks and incumbent cognitions about those attributes and (2) that tasks and employee responses to both types of task-relevant constructs should be examined in the organizational contexts in which they occur.

Rosenthal, D.B., and Laurence, J.H. (1988) Job characteristics and military attrition. Alexandria, VA: Human Resources Research Organization FR-88-11.

Studies have consistently found positive relationships between the performance of military recruits and measures of cognitive ability. The DoD therefore relies heavily on such measures to screen recruits and assign them to jobs. Beyond enlistment, there is an appropriate concern to retain high quality personnel, once they have become members of the armed services. The present study is concerned with the relationship between job characteristics and retention. Some 44 occupational characteristics were examined which included work complexity, training times, worker aptitude, temperament, and interest requirements, physical demands, and environmental conditions. These were related to attrition rates and jobs for the FY 1979 through FY 1983 enlisted cohorts from all services. Training times, cognitive aptitude requirements, and work complexity were negatively related to attrition, while strength demands and undesirable working conditions are positively related to attrition.

Sanchez, J.I., and Levine, E.L. (1989) Determining important tasks within jobs: A policy-capturing approach. Journal of Applied Psychology, 74(2), 336-342.

The job holders' process for judging overall task importance was analyzed using a policy-capturing approach. Sixty incumbents of four jobs rated their respective tasks on five dimensions (e.g., task difficulty) and on the criterion, overall task importance. The results indicated that incumbents' judgements of

importance were primarily reflective of task criticality and difficulty of learning the task. Composites of task importance formed from these two component dimensions were found to be more reliable and convergent with average ratings of overall importance than holistic judgments of importance or judgements of relative time spent. In addition, a Q-mode factor analysis indicated that most incumbents used a linear combination of task criticality and difficulty of learning the task regardless of the job they held, suggesting that a composite of these two measures may be generalizable across jobs.

Scandura, J.M. (1984) Structural (cognitive task) analysis: A method for analyzing content: III. Validity and reliability. Journal of Structural Learning, 8(2), 173-193.

Discusses methods for determining reliability and validity using experts and nonexperts to evaluate sample size, empirical evidence, content and populations, and objective methods. A study involving the informal expert and systematic nonexpert analyses showed that structural analysis had considerable reliability and validity as a method. It is suggested that traditional task analysis has become too cumbersome and that the structural analysis method is needed in dealing with computers.

Schmidt, F.L., and Hunter, J.E. (1981) Employment testing: Old theories and new research findings. American Psychologist, 36(10), 1128-1137.

Claims that cognitive ability tests of the kind generally used in personnel selection are valid predictors of successful performance for jobs in all settings. This controversial stance is supported by analyses that recast findings of invalid tests as instances of Type 1 error. Ideally, if an employer has large enough samples, perfectly reliable tests, and an unrestricted range of ability in the applicant pool, the most widely used types of standardized tests should be valid in all job situations, and the notion of job-specific validity would no longer hold. The authors argue against previous reservations about the suitability of cognitive ability tests for employee selection that were made on the basis of their supposed limited applicability, their bias, and their ultimate contribution to workforce productivity.

Schmidt, F.L., Hunter, J.E., Outbridge, A.N. (1986) Impact of job experience and ability on job knowledge, work sample performance, and supervisory ratings of job performance. Journal of Applied Psychology, 71(3), 432-439.

Based on data from 4 independent studies reported by R. Vineberg and E.N. Taylor (1972) with a total sample size of 1,474, path analysis was used to examine the causal impact of job experience on job knowledge, performance capability as measured by job sample tests, and supervisory ratings of job performance. Findings support the conclusion (1) when mean job experience is 2-3 yrs, there is substantial variance in job experience and (2) when the jobs are of an intermediate complexity level, job experience has a substantial direct impact on job knowledge and a smaller direct impact on performance capabilities as assessed by job sample measures. Job experience also has a substantial indirect effect on work sample performance through its effect on job knowledge, which, in turn, was found to be the strongest determinant of work sample performance. The pattern and magnitude of casual effects of general mental ability were similar to those of job experience. The effect of job knowledge on supervisory ratings were several times stronger than the effect of job sample performance, confirming the findings of J.E. Hunter (1983). When job experience was held constant, the direct impact of ability on the acquisition of job knowledge increased substantially, and this, in turn, increased the indirect effect of ability on job sample performance.

Schmidt, F.L., Hunter, J.E., Outerbridge, A.N., and Goff, S. (1988) Joint relation of experience and ability with job performance: Test of three hypotheses. Journal of Applied Psychology, 73(1), 46-57.

Data from four different jobs (N=1,474) were used to evaluate three hypotheses of the joint relation of job experience and general mental ability to job performance as measured by (a) work sample measures, (b) job knowledge measures, and (c) supervisory ratings of job performance. The divergence hypothesis predicts an increasing difference and the convergence hypothesis predicts a decreasing difference in the job performance of high and low mental ability employees as employees gain increasing experience on the job. The noninteractive hypothesis, by contrast, predicts that the performance difference will be constant over time. For all three measures of job performance, results supported the noninteractive hypothesis. Also, consistent with the noninteractive hypothesis, correlation analyses showed essentially constant validities for general mental ability (measured earlier) out to 5 years of experience on the job. In addition to their theoretical implications, these findings have an important practical implication: They indicate that the concerns that employment test validities may decrease

over time, complicating estimates of selection utility, are probably unwarranted.

Schmidt, F.L., Hunter, J.E, and Pearlman, K. (1981) Task differences as moderators of aptitude test validity in selection: A red herring. Journal of Applied Psychology, 66(2), 166-185.

Two studies, with a total sample size of 400,000 Ss and with the US Department of Labor's Dictionary of Occupational Job Titles (1977), examined the traditional belief that between-job task differences cause aptitude tests to be valid for some jobs but not for others. Results indicate that aptitude tests are valid across jobs, since the moderating effect of tasks (a) is negligible even when jobs differ grossly in task makeup and (b) is probably nonexistent when task differences are less extreme. Findings have implications for validity generalization, the use of task-oriented job analysis in selection research, criterion construction, moderator research, and proper interpretation of the US's Uniform Guidelines on Employee Selection Procedures. It is concluded that the belief that tasks are important moderators of test validities can be traced to behaviorist assumptions introduced into personnel psychology in the early 1960's and that, in retrospect, these assumptions are false.

Schmitt, N., Gooding, R.Z., Noe, R.A., and Kirsch, M. (1984) Meta-analyses of validity studies published between 1964 and 1982 and the investigation of study characteristics. Personnel Psychology, 37(3), 407-422.

The review and meta-analysis of 99 published validation studies for 1964-1982 of the Journal of Applied Psychology and the present journal examined the effect of research design, criterion used, type of selection instrument used, occupational group studies, and predictor-criterion combination on the level of observed validity coefficients. Results indicate that concurrent validation designs produced validity coefficients roughly equivalent to those obtained in predictive validation designs and that both of these designs produced higher validity coefficients than did a predictive design that included the use of the selection instrument. Of the criteria examined, performance rating criteria generally produced lower validity coefficients than did the use of other more "objective" criteria. In comparing the validities of various types of predictors, cognitive ability tests were not superior to other predictors such as assessment centers, work samples, and supervisory/peer evaluations, as has been found in previous meta-analytic work. Personality measures were less valid. Compared to previous validity generalization work, much unexplained variance in

validity coefficients remained after corrections for differences in sample size.

Siegel, A.I., Federman, P.J., and Welsand, E.H. (1980) Perceptual/psychomotor requirements basic to performance in 35 Air Force specialties. US AFHRL TR No. 80-26.

An analysis of the literature relating to taxonomies, measurement consideration, and job analyses yielded a taxonomy containing 13 perceptual/psychomotor classes for various Air Force career fields. The advantages of such a taxonomy are discussed.

Snelgar, R.J., (1983) The comparability of job evaluation methods in supplying approximately similar classifications in rating one job series. <u>Personnel Psychology</u>. 36(2), 371-380.

There is a belief that any job evaluation method, when correctly applied to a series of jobs, will result in approximately the same rating classification as that supplied by any other method for the same job series. The present authors examined the extent to which a number of job evaluation methods differing in methodology and presently in use within South Africa would supply similar classifications. Correlation coefficients among the 16 participating organizations' job evaluation point ratings for a sample of jobs, heterogeneous in terms of type and level within the job hierarchy, ranged from .93 to .99, with an average of .98. Coefficients for the sample of jobs divided into high and low prestige categories ranged from .60 to .99 and .86 to .99 respectively. Correlation coefficients among point ratings for the same organizations but for a 2nd sample of jobs, homogeneous in terms of type and level within the job hierarchy, ranged from .75 to .99, with an average of .90. Results indicate a high degree of agreement among job evaluation methods in assigning point ratings, irrespective of job type and level within the hierarchy.

Sparrow, J. (1989) The utility of PAQ in relating job behaviors to traits. <u>Journal of Occupational Psychology</u>, 62, 151-162.

This study concerns the development of a technology of synthetic validity derived from a structured job analysis technique (the Position Analysis Questionnaire) and its related attribute bank. Attribute profiles are generated on three alternative bases for a sample of seven jobs. The resultant set of profiles are assessed in terms of their reliability. The validities of the alternative approaches are assessed in terms of

the accuracy of indications in relation to the actual mean scores of job incumbents on related aptitude tests. One approach is shown to offer significantly higher levels of reliability validity, and is discussed as a basis for synthetic validation and validity generalization.

Stewart, S.R., (1980) Utility of automation of order of battle and target intelligence data for intelligence analysis. Catalog of Selected Documents in Psychology, 10, 51. MS 2051.

Sticht, T.G., Hooke, L.R., and Caylor, J.S. (1982) Literacy, oracy, and vocational aptitude as predictors of attrition and promotion in the armed services. Alexandria, VA: Human Resources Research Organization PP-2-82.

Analyzed the Literacy Assessment Battery (LAB) data obtained by J. Mathews et al (1978) to develop normative data for the LAB and to relate scores on the LAB to other literacy tests and composite scores of the Armed Services Vocational Aptitude Battery (ASVAB). Additionaly, the lab and other literacy and aptitude data were merged with data on qualification status, attrition, and attained pay-grade contained in the computer files of the Defense Manpower Data Center for 789 Ss. The latter data served as the criteria for evaluating the predictive validity of the LAB and the Armed Forces Qualification Test (AFQT) composite from the ASVAB. Results show that listening comprehension and reading were highly correlated, indicating that Ss who were unskilled at reading were the least skilled in comprehending oral language. The LAB total score correlated almost as well with qualification status as did the AFQT, reflecting the fact that both the LAB and AFQT assess language and reading knowledge and skills. Adding listening skills to the literacy skills assessed by the AFQT improved the accuracy of selection and classification procedures. Education level emerged as the best single predictor of pay-grade achievement, reflecting the practice across the services of using education level as one criteria for promotion. The LAB Auding Paragraphs emerged as the best LAB subtest to supplement the AFQT in predicting pay-grade.

Stone, E.F., and Gueutal, H.G. (1985) An empirical derivation of the dimensions along with characteristics of jobs are perceived. Academy of Management Journal, 28(2), 376-396.

88 undergraduate students (UGSs) in a pilot study, 129 UGSs in the main phase of the present study, and 127 UGSs in a supplementary data-collection phase made judgements regarding the similarity of 20 stimulus jobs to determine dimensions along which job characteristics are perceived. Measures of job

familiarity, job similarity, and main job characteristics, in addition to the Group Embedded Figures Test and a role construct repertory test, were administered to Ss. Data were analyzed with a metric multidimensional scaling algorithm (common space analysis) to identify the dimensions of perceived job characteristics. Analyses revealed that the solutions produced by multidimensional scaling analysis were highly stable across the 3 groups of Ss. The measured individual difference variables did not influence the manner in which Ss perceived jobs. Three dimensions (i.e., job complexity, public service, physical demand) accounted for a substantial proportion of the variance in the original job similarity data, and these 3 dimensions had moderate to strong levels of correlation with Ss' rating of jobs on other measured job characteristics.

Stump, R.W. (1986) What skills will be required for tomorrow's jobs? Journal of Career Development, 12(4), 344-371.

Proposes some skills that might be required in the jobs of the future, with reference to probable characteristics of the future economy and forces shaping jobs in the future. Human talents and capacities that may be required include knowledge, abilities (skills), and attitudes/values. Research results are presented concerning intellectual/attitudinal skills; interpersonal transferable skills; attitudinal transferable skills; occupational adaptability parameters; and mathematic, communication, interpersonal, and reasoning core skills clusters of nonsupervisory and supervisory occupations.

Terpstra, D.E. (1983) An investigation of job-seeker preferences through multiple methodologies. Journal of Employment Counseling, 20(4), 169-178.

242 business undergraduates and 24 business graduate students (174 males and 92 females) ranked 9 fictitious job descriptions according to how willing they would be to accept the job described. Job descriptions were varied in salary level and degree of enrichment. ANOVA showed that Ss were more willing to accept a position with a high or medium salary than a low one; Ss were also more willing to accept a job opening that offered a high or medium degree of enrichment than a low one. Females rank high and medium enrichment jobs higher than males. Pay emerged as the most important job factor for males, while autonomy ranked highest for females. Pay also was more important to older Ss than to younger ones, and supervision was significantly more important to younger Ss than older Ss. Ss with high GPAs viewed both autonomy and task significance as being significantly more important than Ss with lower GPAs; Ss with lower GPAs ranked job security as significantly more important. Pay was more important to Ss whose parents' income was low, and advancement/promotion

was valued more highly by Ss who rated themselves as high on need for achievement.

Thorndike, R.L., (1985) The central role of general ability in prediction. Multivariate Behavioral Research, 20(3), 241-254.

Analyzed 3 data sets--from the Differential Aptitude Tests, the Army General Classification Test, and the US Employment Services General Aptitude Battery--that permitted double cross-validation of a test battery against criterion variables in a number of educational programs or jobs. The validity of the 1st general factor score as compared with that obtained from the set of cross-validated regression weights was found to account, respectively, for approximately 85, 90, 120% as much criterion variance as the cross-validated regression weights. Small, further contributions appeared to be made by Mechanical/Technical and Psychomotor factors. However, for a wide range of criterion variables, the major role in validity appeared to be played by common G (general) factor.

Tornatzky, L.G. (1986) Technological change and the structure of work. In M.S. Pollak and R. Perloff (Eds.) Psychology and work: Productivity, change, and employment. Washington: American Psychological Association. 57-83.

Reviews the major impacts that technology has brought to the American work place over the past two decades. Of particular importance are computer-assisted production and process technologies and the results on the worker of adapting to these technologies. The discussion considers the many advantages of using computer-assisted technologies and the problems of introducing them into the work place. Among some of the effects discussed are job displacement, redistribution of responsibility, and the effects of technology on human skill requirements.

Tziner, A., and Eden, D. (1985) Effects of crew composition on crew performance: Does the whole equal the sum of its parts? Journal of Applied Psychology. 70(1), 85-93.

Varied the composition of Israeli 3-person military crews (mean age 19 yrs) by assigning the male members according to all possible combinations of levels of ability and motivation. Crews performed real military tasks in a military field setting, and unit commanders ranked the effectiveness of their performance at the end of 2 months of military activity. There were 208 crews, or 624 Ss, in all. Findings show that both ability and motivation had an additive effect on crew performance. Crew composition effects were found for ability but not for

motivation. The performance of uniformly high-ability crew members far exceeded the levels expected on the basis of individual crew members' ability, whereas the performance of uniformly low-ability crews fell considerably below the expected level. It is concluded that when crews perform highly interdependent tasks, performance is likely to be affected in a nonadditive manner by crew composition.

Vickers, R.R., and Conway, T.L. (1983) The Marine Corps basic training experience: Psychosocial predictors of performance, health, and attrition. US Naval Health Research Center Report 83-7.

Studied the effects of US Marine Corps basic training (BT) with 2,648 Marine recruits to identify individual differences that must be taken into account to accurately evaluate BT stress effects. Ss were administered a battery of tests including the General Classification Test (GCT), the Levinson Tridimensional Locus of Control Scale, and a background questionnaire. Results showed that the GCT was the primary predictor of performance; race, chance locus of control, high school grades, and repeating a year of school were secondary predictors. Health was not strongly related to any individual difference measure. BT attrition was related to suppression, displacement, expected success in completing the 1st term of enlistment, intelligence, and age. Ss with psychosocial profiles similar to those that predicted BT attrition were less successful in the fleet marine force (FMF). FMF attrition was also associated with less education and more frequent expulsion from school. It is concluded that displacement, suppression, enlistment expectations, age, and GCT scores represent the minimum set of individual differences that must be considered to ensure accurate assessment of BT stress effects and that, in general, Marine Corps attrition is linked to personality characteristics suggesting limited ability to adapt to stress, poor motivation, and mild social delinquency.

Zimmerman, R., Jacobs, R. and Farr. J.A. (1982) A comparison of the accuracy of four methods for clustering jobs. Applied Psychological Measurement, 6(3), 353-366.

Examined 4 methods of cluster analysis for their accuracy in clustering simulated job-analytic data. The methods included hierarchical mode analysis, J.H. Ward's (1963) method, k-means method from a random start, and k-means based on the results of Ward's method. 30 data sets that differed according to number of jobs, number of population clusters, number of job dimensions, degree of cluster separation, and size of population clusters were generated using a Monte Carlo technique. Results from each of the 4 methods were then compared to actual classifications.

The performance of hierarchical mode analysis was significantly poorer than that of the other 3 methods. Correlations were computed to determine the effects of the 5 data set variables on the accuracy of each method. From an applied perspective, these relationships indicate which method is most appropriate for a given data set.

Waters, B.K. (1989) Development of a single DoD reading grade level (RGL) scale. Paper presented at 97th Annual Convention, American Psychological Association, New Orleans.

Research has consistently shown that there is a strong relationship between reading ability and job performance in the military. Thus, literacy levels are of great concern to those responsible for setting selection, classification, and training policy. This paper describes the development of a reading grade level scale. Subjects were 20,422 applicants for the armed services including Coast Guard and reserves. They were tested on the ASVAB and on one of six reading tests. Each of the reading tests was administered to more than 3,000 applicants. From these data, a recommended DoD RGL scale was developed, and it is proposed for DoD-wide use.